Occurrence of *Coptotermes vastator* (Isoptera: Rhinotermitidae) on the Island of Oahu, Hawaii

by

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ABSTRACT

This report details recent collections of *Coptotermes vastator* Light (Isoptera: Rhinotermitidae) made on the island of Oahu, Hawaii in 1999-2000. *Coptotermes formosanus* Shiraki is widely distributed throughout Oahu, while *C. vastator* currently appears to be restricted to the leeward (east) coast of the island from Barber's Point Naval Air Station to Hickam Air Force Base. The restricted distribution of *C. vastator* and the proximity to military bases suggest that the introduction(s) may have occurred recently; possibly via military traffic with Guam and/or the Philippines, two areas which have large populations of this termite. Although *C. vastator* and *C. formosanus* are very similar in appearance, morphological differences among the soldiers and alates of these two species can be used to differentiate them.

INTRODUCTION

Prior to 1997, four species of termites were considered to be established in Hawaii: three drywood (Kalotermitidae) termites, *Neotermes connexus* Snyder, *Incisitermes immigrans* Snyder, and *Cryptotermes brevis* (Walker); and a single subterranean (Rhinotermitidae) termite, *Coptotermes formosanus* Shiraki (Zimmerman 1948, Bess 1970). Recently, it was discovered that two additional drywood termites, *Cryptotermes cynocephalus* Light (Scheffrahn *et al.* 1999) and *Incisitermes minor* Hagen (Woodrow & Grace, unpublished data) were established (although with very limited distributions) on the island of Oahu. Recent survey efforts have also documented that *Zootermopsis angusticollis* Hagen (Termopsidae) is established on the island of Maui in the vicinity of Kula, and possibly also on windward Oahu (Woodrow & Grace, unpublished data).

Coptotermes vastator Light was recently identified as the primary structural pest termite in Guam, a role previously attributed to *C.*

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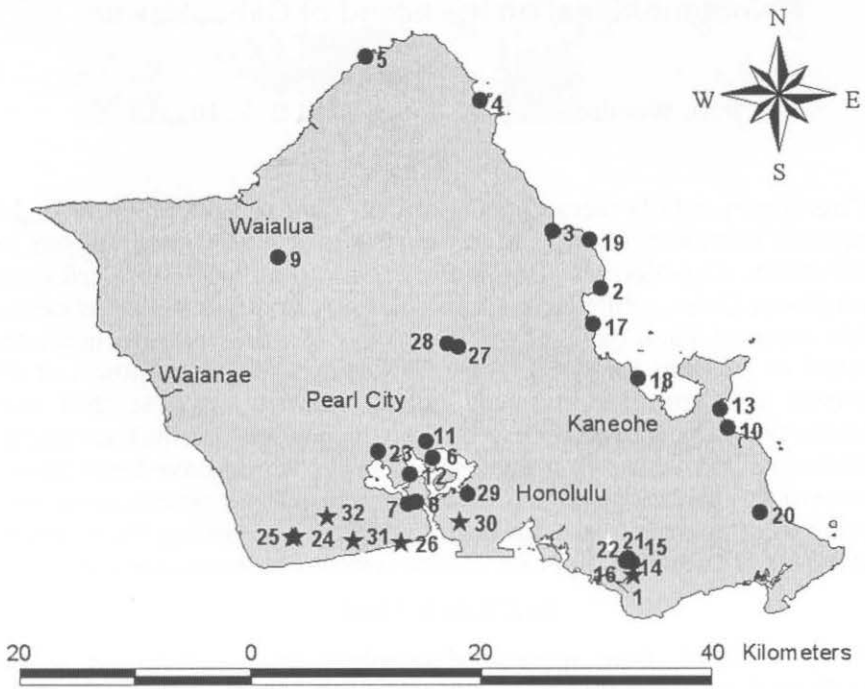


Fig. 1. Collections of *Coptotermes vastator* and *Coptotermes formosanus* made on the island of Oahu in the course of a survey focusing largely on infested vegetation and public areas. *Coptotermes vastator* alates were originally collected on damaged timbers in a Kaimuki residence in 1963 (site #1), although no subsequent collections have been made in this area. Mixed castes of *C. vastator* were collected from an unknown species of dead tree (site #24), and the interior wall framing of structures (sites #25 and #30), from sea grape trees (*Cocoloba uvifera*) at Ewa Beach Park (site #26), and from hay and wooden monitoring stakes at Barbers' Point Riding Stables (site #32). Alates only were collected from the interior of a residence in Ewa Beach (site #31). ★ = *C. vastator*, ● = *C. formosanus*.

formosanus (Su & Scheffrahn 1998). Although *C. vastator* was collected on Oahu in 1963 from damaged timbers in a residence in Kaimuki (Honolulu) (Bess 1966, 1970; Weesner 1965), this residence was removed when the H1 freeway was constructed and no longer exists, and no additional collections of this species have been made in Hawaii in the intervening years. As a result, *C. vastator* has long been considered to be a potential threat to Hawaii, but no evidence, beyond the single 1963 collection, of an established population had been found until our present report. However, we report here six recent collections of *C. vastator* along an 8.5 km portion of the leeward (west) coast of Oahu, which indicate that this species is in fact established on the island.

MATERIALS AND METHODS

Subterranean termites were collected from research sites throughout Oahu and as part of an ongoing termite survey of the Hawaiian Islands in 1998-99 (Woodrow & Grace, unpublished data). Termites collected from research sites were removed from wooden traps (Tamashiro *et al.* 1973) or Sentricon™ termite monitoring stations that were being used for field research. The systematic survey methodology consisted of sampling within any available suitable habitat at ca. one mile distances along roads around the circumference of the island, in order to obtain as large a geographic sample as possible. Access was obtained to U.S. Navy properties, and samples were taken in available roadside areas. Suitable habitat was that which contained living or dead standing trees or other wooden debris that could serve as food and/or habitat for termites.

At each survey location a 15-min search was performed. Searching consisted of looking for any evidence of termites (frass, wings, galleries/damage, foraging tubes, living termites) by inspecting all woody vegetation and/or wooden structures and breaking and/or cutting into dead logs, breaking dead limbs (from living or dead trees), stripping dead bark and turning over dead logs. The survey was focused more on wood-dwelling termites than on subterranean termites, due to the cryptic habitat of the latter; but any visible evidence of subterranean species led to their collection as well. Termites were collected using soft forceps and/or an aspirator, and infested wood was brought back to a laboratory were termites were extracted using hatchet and hammer. Once collected, termites were placed in 70% ethanol and retained in the reference collection in our laboratory (Department of Plant & Environmental Protection Sciences, University of Hawaii at Manoa).

Additional collections of *C. vastator* in 2000 resulted from a collection by a civilian military employee supervising termite control treatments of an infested structure at Hickam Air Force Base, and from queries from a homeowner in Ewa Beach and a user of the Barber's Point Riding Stables.

RESULTS AND DISCUSSION

In our 1988-89 survey, we sampled a total of 180 sites on the island of Oahu, and subterranean termites (*Coptotermes* spp.) were collected from 28 of those sites (Fig. 1). Twelve of these survey sites represent research field colonies or Sentricon™ termite monitoring stations. Of the survey collections of *Coptotermes* spp., five were from trees, eight from man-made structures, two from rotten wood in ground contact,

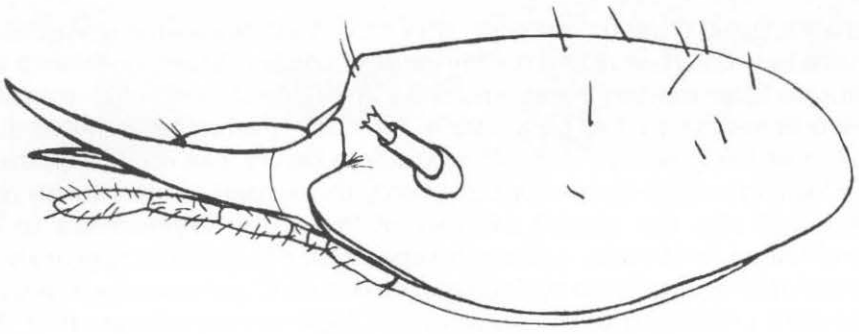
and a single collection from a telephone pole. In total, *C. formosanus* was collected from 25 locations, which were distributed throughout the island.

During the systematic survey, *C. vastator* was found in three separate sites on the leeward (southwest) coast (Fig. 1). Collections #24 and #25 were made in a military housing area on the Barber's Point Naval Air Station on 1 July 1999: collection #25 was from the infested inside wall of an abandoned residence, while #24 was from an unknown dead tree next to a separate residence. Although sites #24 and #25 were reasonably close (270 m), it is unlikely that they represent the same colony, if *C. vastator* foraging ranges are similar to those of *C. formosanus* (Lai 1977). At the third survey site (#26) *C. vastator* workers and soldiers were collected from living sea-grape trees (*Cocoloba uvifera*) at Ewa Beach Park on 25 November 1999. Subsequent inspections noted *C. vastator* activity in rows of trees along either side of the beach park. All specimens collected during the survey were from active colonies and identifications to species were based the setal characters of the soldier caste (Fig. 2).

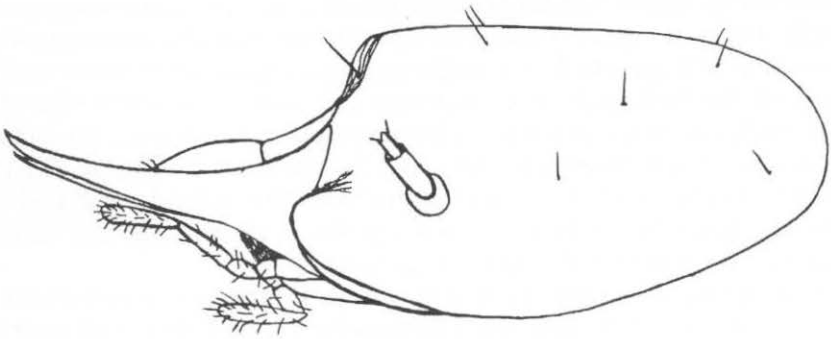
Three additional collections of *C. vastator* were made in 2000 as a result of reports to us of subterranean termite infestations from the public and colleagues. Mr. Henry Miyamoto, a civilian military employee, made the fourth collection of *C. vastator* on 3 April 2000, during termite control treatments of an infested building at Hickam Air Force Base (Site #30). Mr. Miyamoto noticed that winged alates emerging from damaged structural lumber were smaller in size than *C. formosanus* alates that he had commonly encountered, and were much darker in color. He collected alates, workers, and soldiers from this single infested structure, and contacted one of us (Grace), who identified the soldiers and alates as *C. vastator*.

Our fifth collection of *C. vastator* consisted of alates found by residents inside their home on Pupu Street in Ewa Beach in May 2000 (site #31). Then, in August 2000, a sixth infestation of *C. vastator* was discovered in the Barber's Point Riding Stables (Site #32) after a user of the facility reportedly found termites in bailed hay and reported it to one of us (Woodrow). Soldiers collected from the hay, and subsequently from stakes and collection traps installed around the stables, were confirmed to be *C. vastator*.

Coptotermes vastator has had a long history in Hawaii, but multiple established populations have not been previously found. The earliest record of *C. vastator* in Hawaii is a report (#536) of the Division of Plant Inspection of the Hawaii State Board of Agriculture in 1918 (Ehrhorn 1934). This record was of an interception of *C. vastator* in banana



Coptotermes formosanus



Coptotermes vastator

Fig. 2. Comparison of *Coptotermes formosanus* and *Coptotermes vastator* head morphology. Note the presence of 2 setae (2 pairs, total) on each side of the fontanelle of *C. formosanus*, while *C. vastator* has only a single setum on each side of the fontanelle (one pair, total).

stumps shipped from Manila, Philippines. In 1963, alates were found on heavily infested timbers from a residential structure in Kaimuki (Honolulu) on the island of Oahu (Fig. 1, site #1) (Bess 1966, 1970; Weesner 1965). This residence was subsequently demolished to make way for the H1 Freeway (M. Tamashiro, personal communication). Although Bess (1970) was convinced that this species was established given several "suspect" colonies, these reports were never confirmed and *C. vastator* was listed as adventitious. However, the present finding, because it represents at least six separate colonies spread over a distance of 8.5-km, indicates that the *C. vastator* is well established on Oahu.

The current restricted distribution of *C. vastator* suggests a relatively recent introduction. The proximity of the collections to military air

bases suggests that the mode of entry could have been through military traffic between Hawaii and the Philippines and/or Guam, both of which contain large military bases and have large populations of *C. vastator* (Su & Scheffrahn 1998, Light 1929). Su & Scheffrahn (1998) noted that the most likely source of the *C. vastator* in Guam was the Philippines.

Coptotermes vastator represents only the second subterranean termite and also the second member of the genus *Coptotermes* to be established in Hawaii. Although very similar in general appearance, alates of *C. vastator* can be distinguished from *C. formosanus* based on the dark coloration of the dorsum and light brown coloration of the ventral surface, while *C. formosanus* is entirely a light yellowish-brown in coloration (Su & Scheffrahn 1998). *Coptotermes vastator* alates also have distinct crescent shaped "antennal spots", which are absent in *C. formosanus* alates, and large ocelli that almost touch the compound eye (Light 1929, Weesner 1965). The soldier caste is also distinguishable based on the presence of a single pair of dorso-lateral setae near the base of the fontanelle of *C. vastator* (one setum on each side of the fontanelle) while *C. formosanus* has two such pairs of setae (one pair on each side of the fontanelle) (Su and Scheffrahn 1998) (Fig. 2). Light (1929) also noted that *C. vastator* soldiers have a long tongue-shaped labrum that extends beyond the midpoint of the mandibles, although this feature was not obvious in our specimens.

Coptotermes vastator is the principle pest of structures in Guam (Su & Scheffrahn 1998) and the Philippines (Light 1929). The potential economic impact of *C. vastator* in Hawaii is a matter of conjecture at this point. Currently, *C. formosanus* is firmly established and widespread on the island of Oahu and the other major Hawaiian Islands, costing residents ca. $100 million annually (Tamashiro *et al.* 1990). The damage caused by *C. vastator* is also rapid and severe, as was observed at site #25 (Fig. 1) and #29, and is very similar in appearance to that of *C. formosanus*. Based upon the severity of attack of this termite in Guam and the Philippines, *C. vastator* will clearly add to termite problems in Hawaii as its distribution increases. Whether competitive or agonistic interactions with established *C. formosanus* colonies will help to limit that distribution is a subject of current investigation in our laboratory.

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