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Establishment of *Nasutitermes corniger* (Isoptera: Termitidae: Nasutitermitinae) on Abaco Island, The Bahamas

Rudolf H. Scheffrahn^{1,*}, James W. Austin², James A. Chase³, Benjamin Gillenwaters¹, John R. Mangold⁴, and Allen L. Szalanski⁵

Nasutitermes corniger (Motschulsky) (Isoptera: Termitidae) is the most widely distributed higher termite in the Neotropics and is the only termitid to have become established beyond its endemic range (Scheffrahn et al. 2005), almost certainly by human transport. Although this

termite is a pest of wood in service, its epigeal foraging behavior and arboreal nesting habits allow for easy detection (Scheffrahn et al. 2014). In 2000, as part of a larger termite diversity study of The Bahamas and the Turks and Caicos Islands (Scheffrahn et al. 2006; Fig. 1), we surveyed

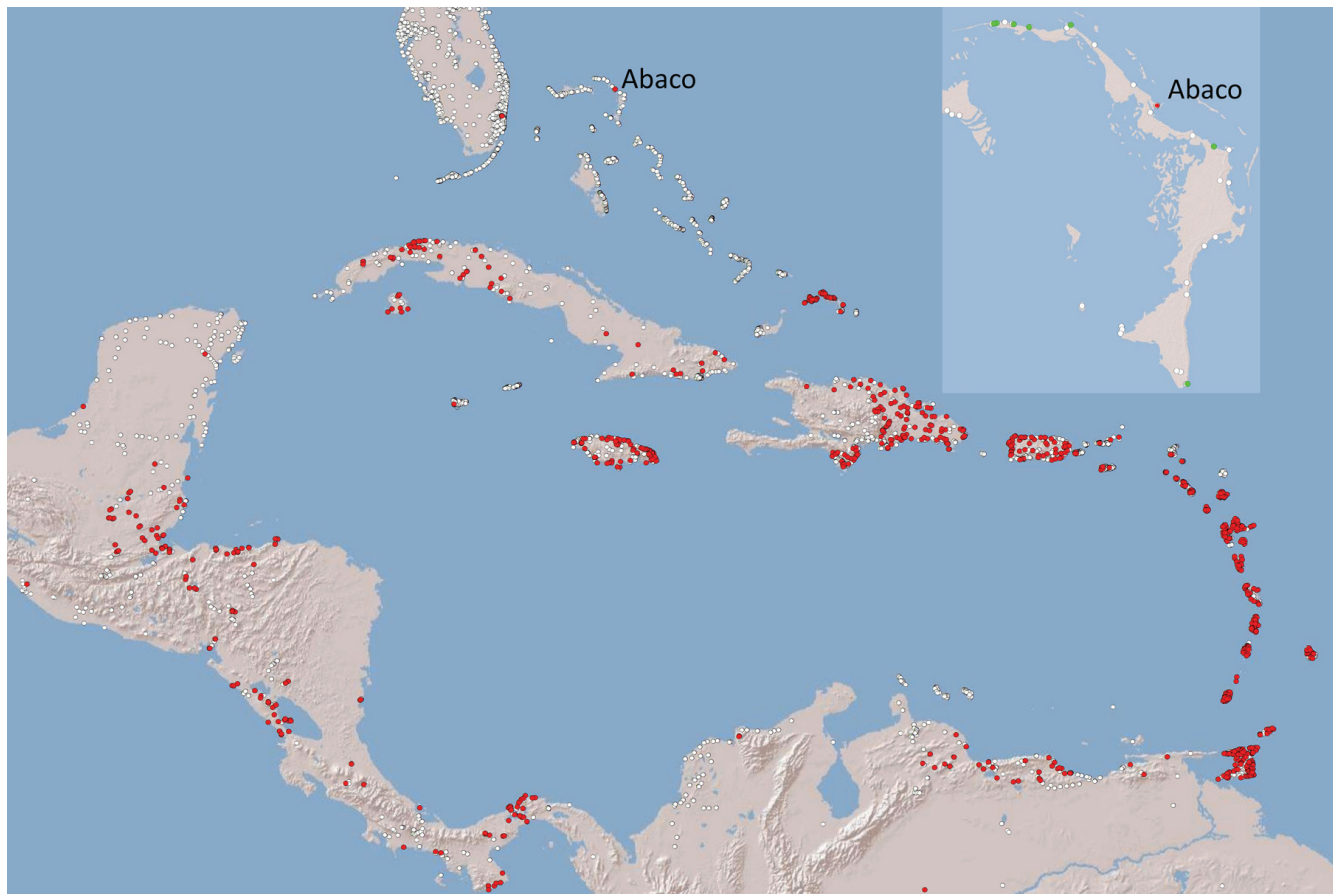


Fig. 1. Caribbean Basin termite localities recorded in the University of Florida Termite Collection. *Nasutitermes corniger* localities (red dots) and non-*N. corniger* localities from 2000 (white dots). Inset: Abaco Island with 2015 non-*N. corniger* localities (green dots).

¹Fort Lauderdale Research and Education Center, 3205 College Avenue, Davie, Florida 33314, USA; E-mail: rhsc@ufl.edu (R. H. S.), bgillenwaters15@ufl.edu (B. G.)

²BASF Corporation, 26 Davis Drive, Research Triangle Park, North Carolina 27709, USA; E-mail: james.austin@basf.com (J. W. A.)

³1147 Dogwood Forest Drive, Marietta, Georgia 30068, USA; E-mail: termites.jc@gmail.com (J. A. C.)

⁴Terminix International, 860 Ridge Lake Boulevard, Memphis, Tennessee 38120, USA; E-mail: jmangold@terminix.com (J. R. M.)

⁵University of Arkansas, Dept. Entomology, 319 Agricultural Bldg., Fayetteville, Arizona 72701, USA; E-mail: aszalan@uark.edu (A. L. S.)

*Corresponding author; E-mail: rhsc@ufl.edu (R. H. S.)

Abaco Island. We expended about 120 collector-hours surveying along the length of the island, including Treasure Cay (Fig. 1, inset), and collected 201 colony samples consisting of 14 species. No *N. corniger* was encountered on Abaco, or any of the other 24 Bahamian islands, among the 3,006 colony samples collected (Scheffrahn et al. 2006). In 2005, Anthony Kemp, a long-time termite control operator on Abaco, found *N. corniger* on Treasure Cay (Scheffrahn et al. 2006) and immediately recognized it as new to the island. As in Florida (Scheffrahn et al. 2002), this was the first establishment of the subfamily Nasutitermitinae in the northern Bahamas. In 2007, Mr. Kemp collected a second sample of *N. corniger* near the 2005 location. Since 2007, he reported 3 additional infestations of *N. corniger* on Treasure Cay. In the most recent observation (Aug 2015), he found nests in a vacant lot adjoining the Treasure Cay Community Centre (Fig. 2). The purpose of this study was to determine the spatial extent of *N. corniger* on Abaco 10 yr after its discovery.

We conducted a survey of Treasure Cay in Sep 2015 specifically for *N. corniger* by using previously established techniques (Scheffrahn et al. 2014). Starting at the original 2005 site, we surveyed for *N. corniger* active sites by extending the search area until no more *N. corniger* were observed. All live collections were made in or immediately near woody growth from foraging tubes, nests, and attacked surfaces. No structures were surveyed. Coordinates of active *N. corniger* sites more than 7 m apart were recorded using a hand-held GPS receiver (Garmin

eTrex® 10). DNA was extracted from 27 individual termites, representing newly established populations undocumented from prior surveys of Abaco Island, by using a salting out protocol (Sambrook & Russell 2001), and PCR of a region of the mitochondrial DNA 16S gene was done per Austin et al. (2012). Consensus sequences were identified and alignment of sequences was done using Geneious software (Auckland, New Zealand).

Nasutitermes corniger was evident at the original 2005 discovery site, and at 42 additional active sites were detected with a search bias for the most distant locations from the original 2005 site. The maximum distances from the 2005 site equaled 817 m (WNW), 313 m (NW), 178 m (ESE), 303 m (S), and 921 m (SW) from the 2005 site (Fig. 2). The total area encompassed by *N. corniger* on Treasure Cay was about 40 ha, based on the area of the polygon joining the active sites that form the infestation perimeter. We did not find any *N. corniger* elsewhere on Abaco Island in 2015 although we did collect 12 other species at 7 other survey sites (Fig. 1; inset). No genetic variation was observed, and all 27 DNA sequences belonged to the same haplotype. This haplotype was not one of the haplotypes observed in a previous study of *N. corniger* genetic variation by Scheffrahn et al. (2005).

As with the Dania Beach, Florida, infestation (Scheffrahn et al. 2014), the mode and date of establishment of *N. corniger* on Treasure Cay, Abaco, cannot be determined. However, establishment by a dis-



Fig. 2. Treasure Cay area, Abaco Island, The Bahamas infested by *Nasutitermes corniger*. Original 2005 *N. corniger* locality (white square), September 2015 live collection sites (black and white dots), and Treasure Cay Community Centre (C.C.). Imagery date: 31 Oct 2014, Google Earth®.

persal flight from an infested boat (Scheffrahn & Crowe 2011) is the most plausible explanation, considering that Abaco is visited by private vessels that were potentially infested by *N. corniger* from elsewhere in the West Indies or Caribbean Basin (Fig. 1). Alates could have flown from an infested vessel toward terrestrial light sources during their crepuscular flights and initiated a cryptic incipient colony that would become visible in 1 to 2 yr (Scheffrahn et al. 2014). The closest marine vessel docks are 100 m from the easternmost *N. corniger* locality at Treasure Cay (Fig. 2), well within their estimated 200 m mean flight distance (Tonini et al. 2014). The public marina at Treasure Cay, built in 1963, is contiguous with many private slips and protected water anchorage. Our genetic analysis of 27 specimens provides evidence that they are of a single introduction.

In comparison with Abaco, the total known area encompassed by *N. corniger* in Dania Beach, Florida, was about 13 ha. Populations from that area were extirpated by insecticidal treatment from 2003 to 2010, and an additional 7 ha discovered in 2012 were also treated (Scheffrahn et al. 2014, Fig. 9 therein). As on Abaco, there is an abundance of marine dockage in Dania Beach close to the *N. corniger* infestations. Based on nest location and size, it was estimated that the Dania Beach infestation was established around 1991 to 1993 (Scheffrahn et al. 2002). Using individual or lattice-based spread models (Tonini et al. 2014) for a single-point establishment of *N. corniger*, the total infestation in Dania Beach could have encompassed $32 \text{ ha} \pm 8 \text{ SD}$ or $38 \text{ ha} \pm 7 \text{ SD}$, respectively, had no insecticidal treatments been used. This area is remarkably close to our estimate of occupied area for *N. corniger* on Abaco and suggests that the Treasure Cay infestation may have been established around 1995.

Scheffrahn et al. (2014) documented several of the confounding issues that this eradication program presented and how they may have compromised the goal of extirpation, but nonetheless how efforts for eradication of *N. corniger* continue in Dania Beach. If the infestation on Abaco is not addressed, it will continue to expand. Although this outcome would be unfortunate, it would provide a long-term opportunity to study the dispersal dynamics of this termite.

Summary

Ten years after its discovery, a survey of the exotic termite *Nasutitermes corniger* (Motschulsky) (Isoptera: Termitidae) on Abaco Island, The Bahamas, revealed an infested area of about 40 ha. The age and spread of the Abaco infestation is remarkably similar to the introduced *N. corniger* population in Dania Beach, Florida. Survey evidence corroborated that both dispersal at the Abaco location and lack of genetic variation (from its subsequent spread) of this

established population point to a single introduction event fostered through a maritime introduction.

Key Words: exotic; termite; survey; single introduction event

Sumario

Diez años después de su descubrimiento, un sondeo de la termita exótica *Nasutitermes corniger* (Motschulsky) (Isoptera: Termitidae) en la isla de Abaco, Bahamas, reveló un área infestada de aproximadamente 40 hectáreas. La edad y la propagación de la infestación en Abaco es notablemente similar a la población *N. corniger* introducida en Dania Beach, Florida. La evidencia del sondeo se corroboró que tanto la dispersión en el lugar en Abaco como la falta de variación genética (de su propagación subsecuente) de la población establecida indica un solo evento de introducción fomentada a través de un evento de introducción marítima.

Palabras Clave: exótico; termita; encuesta; evento introducción singular

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