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Source: Florida Entomologist, 86(1) : 73-79

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2003)086[0073:NPANDT]2.0.CO;2

NEOTERMES PHRAGMOSUS, A NEW DAMPWOOD TERMITE (ISOPTERA: KALOTERMITIDAE) FROM SOUTHEASTERN CUBA

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ABSTRACT

Neotermes phragmosus n. sp. is described from the imago and soldier castes. The imago head capsule of *N. phragmosus* has a distinctly phragmotic and concave frons. Plesiomorphic characters of *N. phragmosus* unique among the Kalotermitidae include partial separation of the otherwise fused first and second marginal teeth of the left imago/worker mandible, long subcosta and radius, and increased number of antennal articles in both imagos and soldiers. This species is confined to the xeric coastal habitats of southeastern Cuba.

Key Words: new species, taxonomy, West Indies, Greater Antilles, Caribbean

RESUMEN

El *Neotermes phragmosus* n. sp. es descrito de la casta imago y la casta soldado. La cápsula de la cabeza del imago *N. phragmosus* tiene el frente distintivamente fragmotico y cóncavo. Las características plesiomorficas del *N. phragmosus* son únicas entre los Kalotermitidae incluyen la separación parcial de los primeros y segundos dientes marginales de la mandíbula izquierda del imago/trabajador, que en otros casos se encuentra fundidos; un subcosta y un radio largados; y un mayor número de artículos en las antenas en los imagos y los soldados. Esta especie está restríngida a la zona árida costera del sureste de Cuba.

A species of *Neotermes*, collected in extreme southeastern Cuba, was originally listed as *Neotermes* sp. nr. *mona* (Banks) (Scheffrahn et al. 1994). A subsequent redescription of *N. mona* (Krecek et al. 2000) revealed that the Cuban *Neotermes* was a new species that is described herein from the winged imago and small and large soldier castes. *Neotermes phragmosus* n. sp. is the fourth *Neotermes* species recorded from Cuba and the sixth from the Greater Antilles. *Neotermes phragmosus* and *N. cubanus* (Snyder) are endemic solely to Cuba (Snyder 1956, data herein). Of the two additional Cuban species, *N. castaneus* (Burmeister) is also recorded from the Bahamas, Cayman Islands, Florida, Hispaniola, Jamaica, and Turks and Caicos Islands (Scheffrahn et al. unpublished), while *N. jouteli* (Banks) ranges into the Bahamas, Cuba, Florida, and Mexico (Scheffrahn et al. 2000). The remaining Greater Antillean species include *N. platyfrons* Krecek and Scheffrahn (2001) from Hispaniola, and *N. mona* from the Bahamas, Hispaniola, Puerto Rico, Turks and Caicos, and Virgin Islands (Krecek et al. 2000).

MATERIALS AND METHODS

The description of *N. phragmosus* is based on 87 colony samples from the authors' collection taken from 23 localities in Guantánamo Province, Cuba, as part of a survey of termites of Cuba and the West Indies (Fig. 4). Collection localities were mapped using ArcView GIS version 3.0a software and relevant map data from Digital Map of the World version 1.0 (Environmental Systems Research Institute, Inc. Redlands, CA). Morphometric data from specimens preserved in 85% ethanol were obtained using a stereomicroscope fitted with an ocular micrometer. Scanning electron micrographs were scanned at 300 dpi, the specimen outline captured with photograph-enhancing software (Adobe Photoshop Elements, Adobe Systems Inc., San Jose, CA), the background converted to black, and the scale bar digitally redrawn. The imago head capsule photomicrograph was obtained using a digitized three-dimensional imaging system (Auto-Montage, Syncroscopy Inc. Frederick, MD) and further enhanced as mentioned above.

The holotype alate and paratype large and small soldier will be deposited at the American Museum of Natural History, New York. The additional alate and soldier paratypes will be submitted to the National Museum of Natural History (Smithsonian Institution), Washington, D.C., and to the Florida State Collection of Arthropods, Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, Florida. The remaining paratypes will be held in the authors' collection at the University of Florida Research and Education Center, Fort Lauderdale, Florida.

NEOTERMES PHRAGMOSUS, NEW SPECIES

Neotermes sp. nr. *mona* (Banks); Scheffrahn et al. 1994: 217 (Cuba).

Imago (Figs. 2 and 3, Table 1).

In dorsal view, head capsule ferruginous orange, except for slightly darker ferruginous ante-

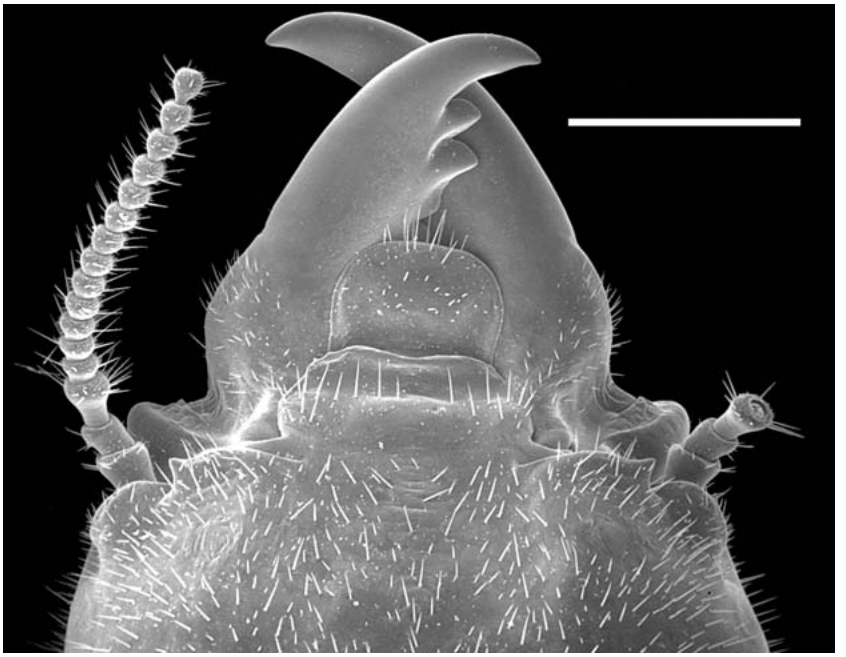

Fig. 1. Scanning electron micrograph of anterior of the large soldier head (dorsal view) of *Neotermes phragmosus* n. sp. from Tortuguilla, Guantánamo Province, Cuba. Scale bar equals 1 mm.

rior frons and postclypeus. Compound eyes almost black. Mandibles chestnut brown. Antennal articles 1-3 ferruginous; remaining articles ferruginous orange. Anteclypeus yellowish. Ferruginous orange chevron patterns formed by wing scales on pterothorax faint and wide; remaining dorsum of body pale orange-yellow. Sclerotized wing venation ferruginous orange, remainder of wings and abdominal sternites yellowish.

In dorsal view, head capsule suboval with sides along and anterior to eyes slightly concave; posterior of head capsule broadly rounded. Head converging to anterior in ventral aspect. In oblique view, frons phragmotic, broadly excavated; depression sharply delimited by moderately raised ridge; surface of frons covered by dense wrinkling of variable orientation (Fig. 2). A pair of tiny tubercles behind ocelli; lateral branches of epicranial suture near tubercles. In lateral view, plane of frons margin slopes weakly toward a slightly convex vertex. Compound eyes large and protruding, subcircular; eye margins narrowly subrectate along ocelli and along posteroventral area, and broadly subrectate or slightly concave along antennal sockets. Ocelli slightly protruding, large, elliptical; contacting or very narrowly separated from eyes; distinctly converging anteriorly. Mandibular bases and anterolateral corners of head capsule with distinct striations. Left mandible with slight hump at basal two-fifths; basal hump with several ~0.03 mm long setae; first and second marginal teeth partially separated; each with separate pointed apex (Fig. 3); third marginal tooth with sinuous anterior and posterior margins. Right mandible with molar plate longer than posterior margin of second marginal tooth and composed of ca. 20 ridges (Fig. 3).

Several dozen setae of medium length (~0.05mm) dispersed on head, pronotum, wing scales, abdominal tergites, and sternites. Antennae with 18-24 articles, 75% (n = 64) with 22-24 articles, 10% with 24; relative length formula 2>3>4 = 5 or 2 = 3>4 = 5. Pronotum robust, about twice as wide as its median length. Pronotum with anterior margin evenly concave, lateral margins faintly convex, posterolateral margins subtruncate or faintly concave, and posterior margin slightly concave medially; anterior and lateral margins with raised and rounded rim. Fore wing with very long subcosta and radius; subcosta terminating at costal margin usually beyond 1/2 of wing length from suture and near intersection of radius and costal margin at 2/3 of wing length. Radial sector with 4-6 branches that fork in apical third of wing just beyond intersection of radius into costal margin. Median vein sclerotized and with about four sclerotized and short posterior branches; branches dissolve gradually into membrane except for usually the two most distal branches, that terminate at wing margin. Wing membrane faintly and irregularly nodulate with some nodules fused. Arolia distinct.

Fig. 2. Photomicrograph of the oblique view of imago head of *Neotermes phragmosus* n. sp. from the U.S. Naval Base, Guantánamo, Cuba, showing deeply excavated and phragmotic frons. Scale bar equals 1 mm.

Comparisons.

The *N. phragmosus* imago is unique among congeners in that its frons is characteristically truncated, depressed, encircled by a ridge, and rugose. Imagos of *N. phragmosus* and the allopatric *N. mona* are the largest among the West Indian Kalotermitidae. The *N. phragmosus* imago has less dense pilosity than *N. mona* on the head, pronotum, and wing scales. Few short setae on basal hump of mandibles present in *N. phragmosus* imago are absent both in *N. mona* and *N. jouteli*.

Compared to the sympatric *N. jouteli*, *N. phragmosus* alates differ primarily in size, the first species being distinctly smaller than the second one, usually without any overlapping. Those most distinctive characters are: 1.77-2.16 mm for head length with labrum of *N. jouteli*, versus 2.24-2.74 mm for *N. phragmosus*; labrum width maximum 0.60-0.70 mm versus 0.74-0.83 mm; pronotum maximum length is 1.06-1.32 mm of *N. jouteli*, but 1.44-1.81 in *N. phragmosus*; and pronotum width with 1.75-2.05 mm, while 2.10-2.59, respectively. Total body length is also useful; 13.92-16.05 mm in *N. jouteli*, versus 15.80-19.04 mm in *N. phragmosus*.

Soldier. (Fig. 1, Tables 2 and 3).

The soldier caste consists of two distinct morphs, large and small, both usually present in mature colonies. Other than size, there are few distinguishing characters that separate small and large soldiers of *N. phragmosus* compared with some congeners and species in several other kalotermitid genera.

Head capsule and labrum ferruginous orange in dorsal view. Antennae ferruginous orange; three proximal articles ferruginous. Anteclypeus pale yellowish. Mandibles glossy, almost black; basal areas dark chestnut. Epicranial sutures faint or absent. Eyes dark gray. Thorax, including femora and abdominal dorsum and sternum pale yellowish. Tibiae and genae pale orange-yellow. Postmentum pale ferruginous.

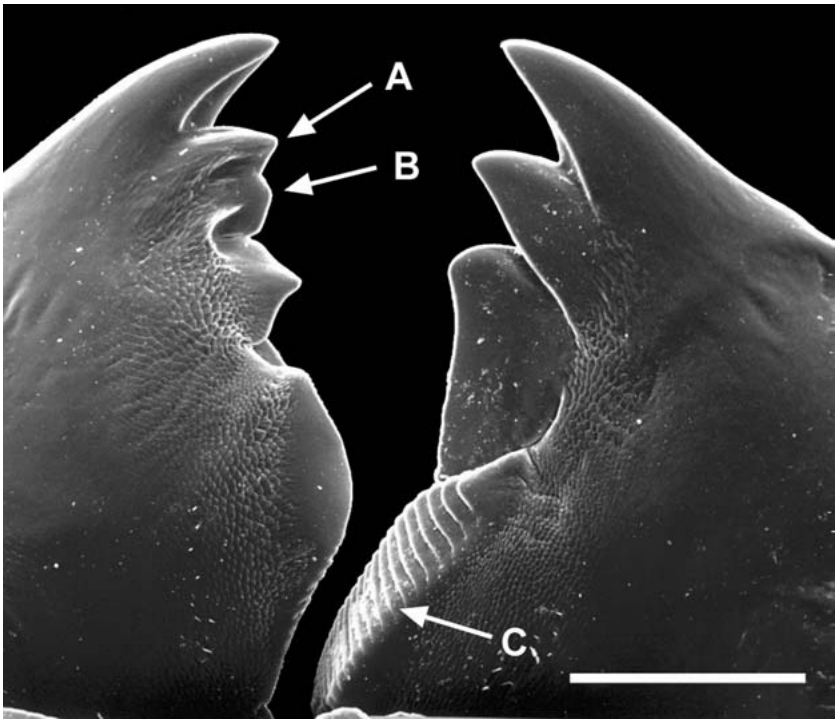

Fig. 3. Scanning electron micrograph of imago mandibles of *Neotermes phragmosus* n. sp., dorsal view, from Tortuguilla, Guantánamo Province, Cuba. Labels: first marginal tooth (A), second marginal tooth (B) of left mandible, and molar plate (C) of right mandible. Scale bar equals 0.5 mm. Labrum removed for clarity.

In dorsal view, head capsule subsquare, with sides subparallel, faintly convex in large soldiers, slightly convex in small morph; posterior corners rounded and posterior margin widely rectate in both morphs. Head capsule, thorax, and abdomen covered with dense mat of long setae (~0.1 mm); occiput glabrous. Frons depressed, faintly submerged, and broadly continuous with postclypeus; depressed area faintly striate. Frontal carinae tapered into distinctly protruding tubercle near antennal carinae. Labrum broadly linguiform; apex slightly convex. Mandibles elongate and relatively robust, with remarkably pilose basal humps; dentition distinct. Small soldier antennae with 17-21 articles, usually 18; large morph with 16-20 articles, usually 18 or 20; third antennal article subclavate, terminal articles usually slightly elongate; antennal formula 2<3>4 = 5. Antennal carinae protruding and faintly rugose. Pronotum papilionaceous, noticeably wider than head, and more than twice as wide as long in middle. Anterior margin of pronotum deeply and evenly concave; anterolateral corners abruptly rounded, sides of pronotum subparallel, faintly convex; posterior margin weakly emarginate. Pterothorax with posterolateral sides subtruncate, more so in small soldiers than in large soldiers. All soldiers with short wing buds.

In lateral view, head capsule dorsoventrally flattened; principal plane of frons occupying about half of head capsule length in small soldiers; about one third in large morph. Frons slopes ≈15° from plane of vertex; mandibles noticeably curved upward; eyes large and vertically oriented; without peripheral satellite facets. Pilosity of frons and anterior vertex dense. Hind femora moderately broadened in small soldiers and noticeably inflated in large morphs.

Comparisons**.**

No single measurement in either soldier morph is diagnostic for separating *N. phragmosus* from its nearest congener, *N. mona*. Nevertheless, the small morph of *N. phragmosus* is larger in the majority of measurements than that of *N. mona*. The mandibular hump pilosity of *N. phragmosus* is considerably more conspicuous than that of both *N. mona* and *N. jouteli*. The *N. phragmosus* soldiers possess a distinctly protruding tubercle on each frontal carina, which, both in *N. mona* and *N. jouteli*, are rudimentary. Striations of frons in *N. phragmosus* are considerable, while absent or very faint in *N. mona*. The rugosity of antennal carinae is faint in *N. phragmosus*, while being well developed in *N. mona.* The eyes of *N.*

TABLE 1. MEASUREMENTS OF *NEOTERMES PHRAGMOSUS* IMAGO.

Measurement in mm (n = 9 males, 10 females from 6 colonies)	Range	Mean ± S.D.	Holotype
Head length with labrum	2.24-2.74	2.58 ± 0.12	2.64
Head length to postclypeus	1.56-2.00	1.86 ± 0.12	1.93
Head width, maximum at eyes	1.83-2.27	2.11 ± 0.093	2.12
Head height without postmentum	1.00-1.19	1.14 ± 0.050	1.18
Labrum width, maximum	0.74-0.83	0.80 ± 0.026	0.80
Eye diameter with sclerite, maximum	0.56-0.68	0.64 ± 0.034	0.67
Eye to head base, minimum from sclerite	0.27-0.38	0.33 ± 0.029	0.34
Ocellus diameter, maximum	0.18-0.26	0.23 ± 0.020	0.22
Ocellus diameter, minimum	0.16-0.20	0.19 ± 0.0098	0.19
Eye sclerite to ocellus, minimum	0-0.016	0.0090 ± 0.0066	0.0082
Pronotum, maximum length	1.44-1.81	1.67 ± 0.10	1.77
Pronotum, maximum width	2.10-2.59	2.44 ± 0.13	2.59
Total length with wings	15.80-19.04	17.88 ± 0.75	17.69
Total length without wings	8.91-13.10	11.35 ± 1.09	12.29
Fore wing length from suture	11.07-13.77	12.93 ± 0.61	13.23
Fore wing, maximum width	3.08-4.07	3.79 ± 0.28	4.07
Hind tibia length	1.60-1.90	1.78 ± 0.089	1.83

phragmosus do not display peripheral facets, which are typical of *N. mona*. Finally, the antennae of *N. phragmosus* soldiers have more articles compared to those of *N. mona*, in which the range is 13-19, 12-18 in *N. jouteli*, while in *N. phragmosus* it is 16-21.

Compared with the sympatric *N. jouteli*, *N. phragmosus* soldiers of both forms differ in having a much wider and much more deeply concave anterior margin of the pronotum. The character is particularly distinctive in large soldiers (pronotum width in *N. jouteli* ranges between 2.61-3.03 mm, while the same measurement in *N. phragmosus* is 3.32-3.96 mm). Pronotal length of *N. phragmosus* large soldiers ranges between 2.15-2.52 mm while in *N. jouteli* the length is 1.71-1.85 mm. Both soldier morphs of *N. phragmosus* are more pilose than *N. jouteli* around the anterior portion of the head including mandible bases. The maximum head width (2.93-3.46 mm) and left mandible length (2.64-2.90 mm) of *N. phragmosus* large soldiers do not overlap with those respective measurements (2.34-2.70 and 2.17-2.42 mm) in *N. jouteli*. Although some small soldier measurements overlap for both species, the *N. phragmosus* small soldier is larger overall than that of *N. jouteli*.

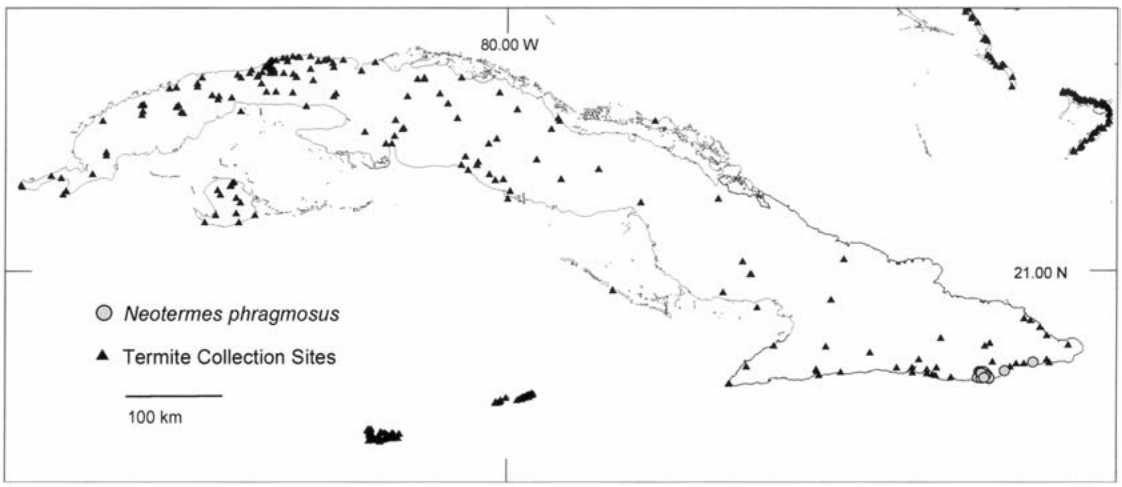

Fig. 4. *Neotermes phragmosus* n. sp. localities and termite collection sites on Cuba and neighboring islands.

TABLE 2. MEASUREMENTS OF *NEOTERMES PHRAGMOSUS* SMALL SOLDIER.

Measurement in mm (n = 12 from 7 colonies)	Range	Mean ± S.D.
Head length to tip of mandibles	3.91-5.30	4.69 ± 0.40
Head length to postclypeus	2.43-3.47	3.04 ± 0.32
Head width, maximum	2.28-3.10	2.77 ± 0.24
Antennal carinae, outside span	2.04-2.60	2.35 ± 0.16
Head height, excluding postmentum	1.34-1.83	1.53 ± 0.15
Labrum, maximum width	0.64-0.82	0.73 ± 0.053
Postclypeus width, maximum	0.87-1.10	0.98 ± 0.066
Left mandible length, tip to most distant visible point of ventral condyle	2.17-2.69	2.42 ± 0.15
Postmentum, length in middle	1.88-2.47	2.17 ± 0.20
Postmentum, maximum width	0.80-1.11	0.93 ± 0.087
Postmentum, minimum width	0.49-0.60	0.54 ± 0.045
Pronotum, maximum width	2.69-3.36	3.07 ± 0.19
Pronotum, maximum length	1.63-2.20	1.93 ± 0.16
Hind tibia length	1.38-1.95	1.71 ± 0.15
Total length	9.72-14.85	12.48 ± 1.67

Etymology.

The species name reflects the unique and striking phragmosis of the imago frons; possibly the most developed for this character among the Isoptera.

Remarks.

The holotype colony was collected in a very xeric coastal habitat from the dead wood of living *Calotropis procera* Aiton (Asclepiadaceae), an exotic shrub. The colony penetrated into xylem elements within the living cambium. Other colonies were collected from dead branches and trunks of mangroves, buttonwood, and other littoral woods. The dispersal flight season of *N. phragmosus* is unknown, but we suspect nocturnal autumn flights similar to those of others congeners as alates were collected in late August and early November.

Type material.

Holotype colony series. **Cuba.** Guantánamo Province; Tortuguilla; 19.98°N, 74.93°W; 20-VIII-1974; coll. J. Krecek; 1 female alate holotype, 13 alate paratypes, 6 paratype small soldiers and 6 paratype large soldiers (CU-968).

Paratype colonies series. All material originates from Guantánamo Prov.: Imias; 20.07°N, 74.64°W; VIII-1975; coll. L. de Armas; 1 paratype small and large soldier (CU-1038). The following samples were collected at the U.S. Naval Base Guantánamo Bay by J. Chase, J. Mangold, and R.H. Scheffrahn 2-XI-2001 to 6-XI-2001: Kittery Beach; 19.906°N, 75.089°W; 1 paratype imago (CU-1076); N. Kittery Beach; 19.905°N, 75.088°W;

Table 3. Measurements of *Neotermes phragmosus* large soldier.

Measurement in mm (n = 11 from 6 colonies)	Range	Mean ± S.D.
Head length to tip of mandibles	5.30-6.09	5.69 ± 0.22
Head length to postclypeus	3.61-4.16	3.87 ± 0.17
Head width, maximum	2.93-3.46	3.25 ± 0.17
Antennal carinae, outside span	2.54-2.97	2.78 ± 0.13
Head height, excluding postmentum	1.83-2.30	2.15 ± 0.14
Labrum, maximum width	0.70-0.83	0.78 ± 0.049
Postclypeus width, maximum	1.06-1.21	1.13 ± 0.046
Left mandible length, tip to most distant visible point of ventral condyle	2.64-2.90	2.77 ± 0.080
Postmentum, length in middle	2.57-3.03	2.79 ± 0.14
Postmentum, maximum width	0.93-1.14	1.06 ± 0.078
Postmentum, minimum width	0.47-0.65	0.58 ± 0.063
Pronotum, maximum width	3.32-3.96	3.66 ± 0.16
Pronotum, maximum length	2.15-2.52	2.33 ± 0.11
Hind tibia length	1.75-2.10	2.01 ± 0.10
Total length	12.83-16.07	13.96 ± 1.13

1 paratype small and large soldier (CU-1343); Old Chief's Club; 19.925°N, 75.131°W; 1 paratype imago (CU-1374); Boat landing, leeward mangroves; 19.941°N, 75.152°W; 1 paratype large soldier (CU-1401); 1 paratype small soldier (CU-1408); Naval Station Brig; 19.936°N, 75.124°W; 1 paratype small soldier (CU-1430); 1 paratype imago (CU-1433); Evan's Point; 19.921°N, 75.141°W; 1 paratype imago (CU-1447); 1 paratype small and large soldier (CU-1448); Leeward mangroves, *Coccothrinax* habitat; 19.958°N, 75.165°W; 1 paratype imago and small soldier (CU-1521), 1 paratype large soldier (CU-1523).

Discussion

The characters of *Neotermes phragmosus* require that morphological definitions for the Kalotermitidae be broadened for both the imago and soldier. Plesiomorphic traits of *N. phragmosis* outside of Krishna's (1961) imago diagnosis include: 1) a maximum of 24 antennal articles (increase of 3), 2) separation of the second and third marginal teeth of the left mandible, 3) the molar plate of the right mandible longer than the posterior margin of the second marginal tooth, and 4) fore wing subcosta extending to at least mid wing with radius intersecting costal margin well beyond mid wing. In the soldier, the number of antennal articles is increased from 19 to 21. It is noteworthy that for the soldier, Kambhampati & Eggleton (2000) use the threshold gap of 20-22 antennal articles to separate the Termopsidae from the Kalotermitidae.

Although a weak frontal concavity and rudimentary phragmosis occur in several Neotropical *Neotermes* imagos, i.e. *N. jouteli* (Scheffrahn et al. 2000), *N. mona* (Krecek et al. 2000), and *N. platyfrons* (Krecek & Scheffrahn 2001), the degree of its development in *N. phragmosus* is remarkable and suggests apomorphism for defense of incipient colonies against predatory ants or competition by termites vying for nuptial microhabitats. The evolutionary significance of pilosity of the mandibular humps in the soldier is unclear. Mandibular basal pilosity is not uncommon in *Neotermes*; it appears also in *Glyptotermes, Paraneotermes,* and *Incisitermes*, but this trait reaches its maximum expression in *N. phragmosus*.

Together with the *Antillitermes subtilis* (Scheffrahn & Krecek 1993), *Constrictotermes guantanamensis* Krecek et al. (1996), *Cryptotermes spathifrons*, and *C. cymatofrons* (Scheffrahn & Krecek 1999), *N. phragmosus* is the fifth species recently described from southeastern Cuba. All species but *C. cymatofrons* are confined to xeric habitats.

Acknowledgments

The authors thank James A. Chase and John R. Mangold, Terminix International, and Luis F. de Armas, Cuban Academy of Sciences, for specimen collection; Tom Drake, Wildlife Technician; Paul Schoenfeld, Natural Resources Manager; Patricia Loop, Environmental Director; USNB Guantanamo Bay, Cuba, for logistical support; Diann Achor, University of Florida, Lake Alfred Citrus Research and Education Center, for assisting with scanning electron microscopy; Lyle Buss and Brian J. Cabrera for assisting with light photomicroscopy; and William Kern Jr. and B. Cabrera for their critical reviewing of this manuscript. Florida Agricultural Experiment Station Journal Series No. R-08789.

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