REDESCRIPTION OF *NEOTERMES MONA*, A DAMPWOOD TERMITE (ISOPTERA, KALOTERMITIDAE) FROM THE CENTRAL WEST INDIES

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ABSTRACT

The winged imago of *Neotermes mona* (Banks) is described for the first time and the soldier caste is redescribed as two size morphs. The distribution of *N. mona* includes Hispaniola, Turks & Caicos Islands, Puerto Rico, and Virgin Islands. It is the largest kalotermitid in this region.

Key Words: taxonomy, Caribbean, Neotropics, distribution, imago

RESUMEN

Se describen por primara vez los adultos alados de *Neotermes mona* (Banks) y se redescribe la casta de soldados como formas de dos tamaños. La distribución de *N. mona* incluye Española, las Islas Turcas y Caicos, Puerto Rico y las Islas Vírgenes. Este es el mayor kalotermitido de esta región.

For his original description of *Neotermes* (=*Kalotermes*) *mona* from Mona Is., Puerto Rico, Banks (1919) offered little more than a brief soldier comparison with *Incisitermes* (=*Kalotermes*) *schwarzi* (Banks) and *N.* (=*K.*) *jouteli* (Banks) (Banks & Snyder 1920). The description of *N. mona* lacked measurements and was accompanied only by a simple line drawing of a soldier's head and pronotum that resembles Krishna's (1961) definition of the genus *Neotermes*. In light of recent collections of *N. mona* from the Turks and Caicos Is. (Scheffrahn et al. 1990), Mona Is. (Ramos 1946, Jones 1993), Dominican Republic, Puerto Rico, and Guana Is., B.V.I. (Scheffrahn et al. 1994, Collins et al. 1997), and now Vieques Is. (Puerto Rico) and St. John, U.S.V.I., we herein redescribe the soldier as a dimorphic caste and describe the winged reproductive for the first time.

MATERIALS AND METHODS

Morphometrics of specimens preserved in 85:15 ethanol:water were made with a stereomicroscope fitted with a calibrated ocular micrometer. Specimens for measurement were selected from 81 colony series collected during 1988-1999 from 50 localities on 10 islands in the West Indies (Fig. 1). Measurements of the large and small soldier morphs are presented separately, but other characters do not differ sufficiently to warrant separate descriptions.

Scanning electron micrograph prints were scanned at 600 dpi, and the digital image outline traced using photograph-enhancing software (Photo Magic, Micrografx, Inc., Richardson, TX). The background was converted to black, and the scale bar was

digitally redrawn. Latitude and longitude coordinates of collection sites were converted to decimal degrees and mapped (Fig. 1) 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).

Neotermes mona (Banks)

Kalotermes mona Banks 1919: 478 [soldier; Fig. 6].
Kalotermes (Neotermes) mona; Snyder *in* Wolcott 1948: 62.
Kalotermes mona; Snyder 1949: 18.
Neotermes mona; Krishna 1961: 322.

Imago (Fig. 2 A-B, Table 1).

In dorsal view, general color almost uniformly ferruginous, except for darker, chestnut brown frons and anterior vertex in majority of specimens, and dark chestnut brown posterior halves of three posterior abdominal tergites. Mandibles dark chestnut brown. Anteclypeus yellowish. Antennae ferruginous orange except for chestnut brown third article. Compound eyes almost black. Chevron pattern on pterothorax faint and wide. Femora yellowish, tibiae ferruginous. Sclerotized wing venation ferruginous, remainder of wings, arolia, and abdominal sternites pale ferruginous orange.

In dorsal view, head capsule suboval with sides rectate and faintly converging to anterior especially in ventral aspect; posterior of head capsule broadly rounded. In oblique view, frons broadly concave, with raised lateral margins, and with delicate striations. In lateral view, frons plane continuous with plane of vertex. Compound eyes large and protruding, subcircular, with long subrectate or slightly concave margins along antennal sockets. Ocelli slightly protruding; comparatively large, oval; broadly contacting eyes. Mandibular bases with striations. Shallow, small, and circular depression centered at intersection of epicranial suture. Head, pronotum, wing scales, abdominal tergites, and sternites with numerous and long setae. Antennae with 19 to 22 articles, usually 21 or 22, relative length formula 2 > 3 > 4 = 5. Pronotum about

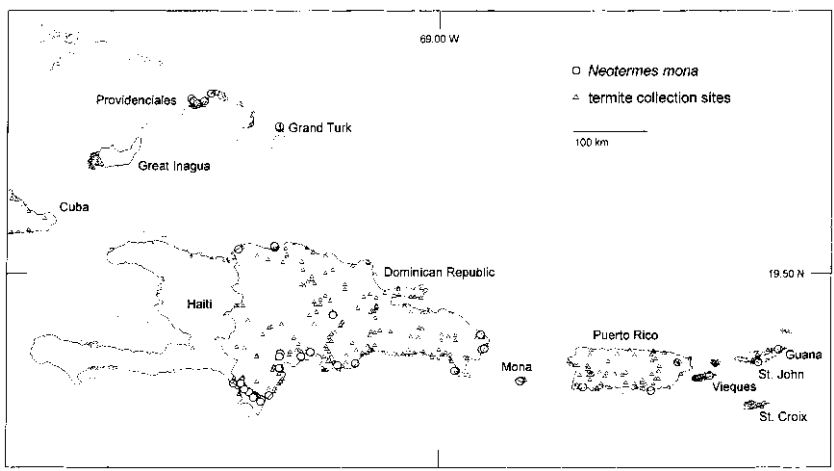

Fig. 1. *Neotermes mona* localities and termite collection sites from 1988-1999.

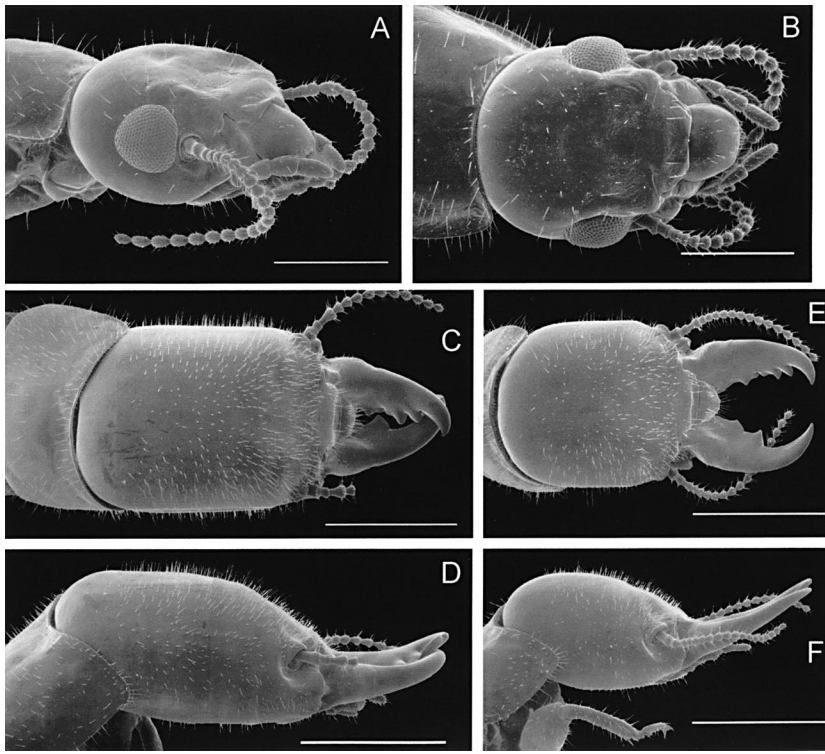

Fig. 2. Scanning electron micrographs of *N. mona*. Oblique (A) and dorsal (B) views of an imago head from Guana Island. Dorsal (C) and lateral (D) views of a large soldier from Guana Island. Dorsal (E) and lateral (F) views of a small soldier from Mona Island. Scale bar equals 1 mm for A-B and 2 mm for C-F.

twice as wide as median length; anterior and lateral margins with raised and rounded rim. Anterior margin of pronotum concave; posterior margin slightly concave. Anterior wings with very long subcosta and radius; subcosta terminating at costal margin near ½ of wing length from suture; radius reaching costal margin at ⅔ of wing length. Radial sector with 4-5 branches along distal half of wing. Sclerotized media with several fine transverse branches to radial sector; posteriorly, few short diagonal and sclerotized branches fade into membrane except for most distal branch that terminates at wing margin. Texture of wing membrane with very faint nodulations. Arolia large.

Comparisons

The alate of *N. mona* resembles that of *N. jouteli*, but the former is larger. Head width at eyes in *N. mona* is ≥2.00 mm, while in *N. jouteli* it is ≤1.81 mm; maximum pronotum width in *N. mona* is ≥2.22 mm versus ≤2.05 mm in *N. jouteli*, and pronotum maximum length is ≥1.49 mm and ≤1.32 mm for *N. mona* and *N. jouteli*, respectively. Total length with wings of the *N. mona* alate is ≥17.89 mm compared to ≤16.05 mm in *N. jouteli*; and wing length from suture is ≥13.35 mm and ≤11.79 mm, respectively. The imago of *N. mona* differs from all other West Indian congeners by its darkened three

TABLE 1. MEASUREMENTS OF *NEOTERMES MONA* IMAGO.

Measurement in mm (n = 5 males, 5 females from 8 colonies)	Range	Mean ± S.D.
Head length with labrum	2.14-2.52	2.38 ± 0.12
Head length to postclypeus	1.63-1.97	1.83 ± 0.10
Head width, maximum at eyes	2.00-2.17	2.10 ± 0.051
Head height without postmentum	1.11-1.21	1.15 ± 0.032
Labrum width, maximum	0.73-0.89	0.82 ± 0.049
Eye diameter with sclerite, maximum	0.57-0.67	0.62 ± 0.033
Eye to head base, minimum from sclerite	0.29-0.38	0.34 ± 0.027
Ocellus diameter, maximum	0.22-0.27	0.24 ± 0.014
Ocellus diameter, minimum	0.16-0.20	0.17 ± 0.011
Eye sclerite to ocellus, minimum	0	0
Pronotum, maximum length	1.49-1.68	1.58 ± 0.068
Pronotum, maximum width	2.22-2.47	2.35 ± 0.095
Total length with wings	17.89-22.01	19.26 ± 1.17
Total length without wings	9.09-11.08	10.08 ± 0.65
Fore wing length from suture	13.35-16.47	14.81 ± 0.80
Fore wing, maximum width	3.56-4.15	3.87 ± 0.17
Hind tibia length	1.77-1.91	1.85 ± 0.041

posterior abdominal tergites. The imago of *N. mona* has a generally darker, ferruginous coloration compared with a lighter ferruginous orange color in *N. jouteli*. The *N. mona* imago has dense pilosity composed of long setae (≤0.3 mm) on the head, pronotum, wing scales, and abdominal sternites and tergites, while the *N. jouteli* imago is adorned with sparse short setae (≈0.03 mm long). The setal follicles of *N. mona* are strikingly lighter than the surrounding cuticle, while in *N. jouteli* the follicles are unapparent. The frons of *N. mona* is on an even plane with the anterior vertex, while in *N. jouteli* there is about a 15° slope between the planes of the frons and vertex.

Although alate pilosity characters of *N. mona* are similar to those of *N. castaneus* Burmeister, *N. castaneus* is smaller overall, has much smaller compound eyes than *N. mona*, and its head color is brownish compared to the ferruginous *N. mona* head. The frons of the *N. mona* alate is faintly concave and delicately striate; in *N.castaneus* the frons is faintly convex and striations are absent.

Soldier (Figs. 2 C-F, Tables 2-3).

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. mona* compared with some congeners and species in several other kalotermitid genera.

Head capsule generally ferruginous in dorsal view, in some specimens postclypeus, frontal carinae and antennal carinae darker, chestnut brown. Thorax and abdominal dorsum ferruginous orange. Mandibles glossy, almost black, with very dark chestnut brown areas near articulations. Epicranial suture faint or absent. Eyes almost black. Femora yellow-white; remaining sternum pale ferruginous orange. Darker ferruginous postmentum contrasting with ferruginous orange genae.

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

Measurement in mm (n = 10 from 9 colonies)	Range	Mean ± S.D.
Head length to tip of mandibles	4.37-5.76	4.85 ± 0.52
Head length to postclypeus	2.77-3.42	3.04 ± 0.22
Head width, maximum	2.31-3.13	2.66 ± 0.24
Antennal carinae, outside span	2.18-2.80	2.40 ± 0.19
Head height, excluding postmentum	1.52-1.93	1.83 ± 0.13
Labrum, maximum width	0.64-0.87	0.71 ± 0.069
Postclypeus width, maximum	0.88-1.18	0.98 ± 0.079
Left mandible length, tip to most distant visible point of ventral condyle	2.24-2.84	2.46 ± 0.18
Postmentum, length in middle	1.88-2.34	2.08 ± 0.14
Postmentum, maximum width	0.78-1.06	0.89 ± 0.077
Postmentum, minimum width	0.44-0.64	0.52 ± 0.056
Pronotum, maximum width	2.73-3.28	2.99 ± 0.18
Pronotum, maximum length	1.63-2.02	1.82 ± 0.10
Hind tibia length	1.60-2.15	1.76 ± 0.16
Total length	9.94-13.35	11.39 ± 1.01

In dorsal view, head capsule subsquare, slightly longer than wide, with sides subparallel in large soldiers, faintly convex in small ones; posterior corners of both morphs rounded; median posterior of head capsule rectate. In some individuals of both morphs, sides of head capsule faintly converging anteriorly. Head capsule covered

TABLE 3. MEASUREMENTS OF *NEOTERMES MONA* LARGE SOLDIER.

Measurement in mm (n = 10 from 8 colonies)	Range	Mean ± S.D.
Head length to tip of mandibles	5.69-6.49	6.07 ± 0.30
Head length to postclypeus	3.81-4.31	4.04 ± 0.17
Head width, maximum	2.87-3.43	3.13 ± 0.20
Antennal carinae, outside span	2.57-3.10	2.87 ± 0.17
Head height, excluding postmentum	1.88-2.47	2.27 ± 0.17
Labrum, maximum width	0.72-0.83	0.78 ± 0.044
Postclypeus width, maximum	1.05-1.19	1.13 ± 0.048
Left mandible length, tip to most distant visible point of ventral condyle	2.67-3.07	2.87 ± 0.13
Postmentum, length in middle	2.77-3.10	2.90 ± 0.12
Postmentum, maximum width	0.96-1.14	1.06 ± 0.067
Postmentum, minimum width	0.49-0.54	0.52 ± 0.022
Pronotum, maximum width	3.37-3.96	3.60 ± 0.21
Pronotum, maximum length	2.00-2.37	2.22 ± 0.12
Hind tibia length	1.93-2.20	2.04 ± 0.091
Total length	11.64-15.62	13.48 ± 1.51

with dense mat of setae except on occiput. Body also covered with dense mat of setae. Frons flattened, usually faintly concave. In small soldiers, frons surface smooth; in some of large soldiers frons with very faint reticulate rugosity. Frontal carinae lobed with short pointed tubercle. Labrum linguiform. Mandibles comparatively long and robust; in large soldiers, slightly more robust, with faint, and slightly pilose basal hump; dentition distinct. Antennae with 13 to 19 articles, usually 16 or 17 in both morphs; in small soldiers often only 13 or 14 articles present; third antennal article subclavate, terminal articles usually markedly elongated; antennal formula $2 < 3 > 4 = 5$. Antennal carinae markedly protruding and rugose. Pronotum about twice as wide as long. Anterior margin of pronotum deeply concave; sides of pronotum slightly convex; posterior margin weakly emarginate. All soldiers with short wing pads on meso- and metathorax.

In lateral view, head capsule slightly dorso-ventrally flattened; frons plane sloping 20° from plane of vertex; mandibles moderately curved upward; eyes moderately elongated or less often subcircular, with peripheral satellite facets. Pilosity of frons and anterior vertex much more dense than on occiput. Hind femora moderately broadened in small soldiers and noticeably inflated in large ones. Postmentum narrowed near middle in large soldiers.

Comparisons

Because of size overlap, biometrical separation of small soldiers of *N. mona* from those of *N. jouteli* is possible only on examination of a series of specimens. Both small and large soldiers of *N. mona* tend to be larger than those of *N. jouteli*. In large soldiers, the following measurements do not overlap between these two species. The maximum head width is ≥2.87 mm and in *N. jouteli* ≤2.70 mm, left mandible length is ≥2.67 mm and ≤2.42, maximum width of pronotum is ≥3.37 mm and ≤3.03 mm, and maximum length of pronotum is ≥2.00 mm and ≤1.85 mm, in *N. mona* and *N. jouteli,* respectively. In large soldiers, the mandibles of *N. mona* are more robust but with less developed basal humps and pilosity than those of *N. jouteli*. In small soldiers, the mandibles are more robust in *N. mona* compared to *N. jouteli*, while pilosity and hump proportions are similar. The body of *N. mona* is generally much more pilose than that of *N. jouteli.* The frontal carinae and adjacent frontal area of *N. mona* soldiers exhibit much denser pilosity than in *N. jouteli* in both morphs, especially in large soldiers. The tergum and sternum of *N. mona* soldiers are conspicuously more pilose than in *N. jouteli*.

Material Examined and Measured

USA. Puerto Rico. All samples collected by J. Chase, J. Mangold, J. de la Rosa and R. Scheffrahn. Bosque de Aguirre; 17.93°N, 66.15°W; 1-VI-1993; 1 small soldier (PR-175); 2 large soldiers (PR-176); 1 small, 2 large soldiers, 3 alates (PR-177). Mona Island. All samples collected by S. Jones. Uvero Beach; 18.06°N, 67.90°W; 11-XI-1992; 1 large soldier (PR-409); S. W. airstrip; 18.06°N, 67.91°W; 12-XI-1992; 1 small soldier, 1 alate (PR-416); same data; 1 small soldier (PR-417). British Virgin Islands. Guana Island. North slope near resort; 18.49°N, 64.44°W; 27-X-1992; J. Krecek; 1 small soldier (no. VI-59); same site; X-1991; L. Hernández; 1 large soldier, 1 alate (no. VI-60); same site; 19-X-1992; Krecek, light trap; 1 alate (no. VI-61). British West Indies. Turks & Caicos Islands. Grand Turk Island. 21.46°N, 71.14°W; 6-II-1990; Scheffrahn, and B. Diehl; 1 small soldier, 1 alate (TC-21). Dominican Republic. Barahona Prov., Cabral/ Barahona Hwy; 18.23°N, 71.13°W; 20-VI-1991; Chase, Mangold, de la Rosa, and Scheffrahn; 1 small, 1 large soldier (DR-27); La Altagracia Prov., Juanillo; 18.48°N,

68.42°W; 11-VI-1992; Chase, Mangold, de la Rosa, and Scheffrahn; 2 small, 1 large soldier (DR-562); Pedernales Prov., 25 km E. Pedernales; 17.92°N, 71.53°W; 28-X-1993; Chase and de la Rosa; 1 alate (DR-864); Puerto Plata Prov., Punta Rucia; 19.88°N, 71.20°W; 21-VIII-1994; Chase, Krecek, de la Rosa, and Scheffrahn; 1 small, 1 large soldier (DR-946); Peravia Prov., 5 km W. Bani; 18.30°N, 70.12°W; 4-VIII-1995; Chase; 1 alate (DR-1209); Pedernales Prov., Pedernales, beach, forest; 18.03°N, 71.74°W; 3-XI-1996; Chase and Krecek; 1 large soldier (DR-1300); Saona Island (new record). La Romana Prov., Punta Catuano; 18.20°N, 68.78°W; 14-III-1995; Chase and de la Rosa; 1 alate (DR-1130).

Additional Material Examined

Paratype: Puerto Rico. Mona Is. No date or collector given; 1 large soldier, 5 small soldiers, 1 presoldier, and many nymphs (MCZ Type 10076). Vieques Island (new record)**.** Between Red Beach and U.S. Navy observation post installation; 21.90°N, 65.37°W; 24-VII-1999; Scheffrahn, Maharajh, and Chase; 1 nymphoid supplementary, many soldiers and nymphs, 2 larvae (PR-648, 650). U.S. Virgin Islands. St. John (new record)**.** Terminus of paved road, Hwy 107; 18.31°N, 64.71°W; 29-VII-1999; Chase; 1 nymphoid supplementary, many soldiers and nymphs (no. VI-97).

Discussion

Long considered endemic to Mona Is. (Wolcott 1948), *N. mona* is now recorded from a wide geography of the central West Indies (Fig. 1). Within this region, Haiti, the larger Caicos Is., and many of the Virgin Is. have not yet been satisfactorily surveyed for termites (Fig.1) and may support populations of *N. mona*. Surveys of Cuba, Jamaica, the Bahamas, and the Lesser Antilles have not yielded collections of *N. mona* (Scheffrahn & Krecek, unpubl. data). A record of *N. mona* from Barbados by Bennett & Alam (1985) is almost certainly based on misidentification. A *Neotermes* species listed as "nr. *mona*" from Cuba (Scheffrahn et al. 1994) is now recognized to be new species (Krecek & Scheffrahn, unpubl. data).

Neotermes mona is the largest kalotermitid in the West Indies. Snyder (1959) mentions that the alate of *N. araguaensis* Snyder, comparable in size with *N. mona*, is the largest *Neotermes* in the New World. At 22, the maximum number of antennal articles for the *N. mona* imago exceeds Krishna's (1961) diagnoses of ≤21 antennal articles for the *Neotermes* and the Kalotermitidae.

Dispersal flights of *N. mona* are nocturnal. On several occasions, JK observed alates flying around lights between 0100 and 0200 hours in the Dominican Republic and Guana Is. in October and December. Compared with some Kalotermitidae (e.g., *Cryptotermes* and *Incisitermes*), the alates of *N. mona* exhibited robust flight behavior and lacked the tendency to shed wings shortly after alighting.

Neotermes mona is usually a coastal inhabitant where it colonizes substantial woody growth of dry littoral forests, including arboreal cacti and mangroves. This species has also been collected from wood in service (Wolcott 1948, Scheffrahn et al. 1990), however its economic significance appears limited. Galleries of *N. mona* infestations occasionally extend into the xylem elements of living trees or near the tidal zone of dead mangrove trunks; possibly as moisture refugia during drought. Collins et al. (1997) rank *N. mona* as the termite species from the British Virgin Is. having the greatest moisture requirements. Their ranking was based on climatological factors of the 19 islands surveyed and not on experimental data. We contend that, contrary to the rankings of Collins et al. (1997), *N. mona* has a substantially lower moisture re-

quirement than sympatric termite species in the families Rhinotermitidae and Termitidae that have soil access.

In a study of the phylogeny of 10 kalotermitid species, Luykx et al. (1990) selected 13 morphological characters (7 imago and 6 soldier) for cladistic analysis. In their data matrix, the eye pigmentation character for the *N. mona* soldier was erroneously scored as being absent, when it is indeed heavily pigmented. As a result, there are no morphological differences for the selected characters among *N. mona* and its primarily allopatric congeners, *N. jouteli* and *N. luykxi* (Nickle and Collins). Therefore, the morphological cladogram of Luykx et al. (1990) must be revised to show these three *Neotermes* as sister species.

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