Zootaxa 5128 (4): 581–588
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5128.4.7
http://zoobank.org/urn:lsid:zoobank.org:pub:65CF7D76-B932-4AAF-A93D-E0E2E33AD06D

Amitermes californicus Banks, 1920 (Isoptera, Termitidae, Termitinae) resurrected after ninety years of synonymy and *A. floridensis* Scheffrahn, 1989 synonymized into *A. wheeleri* (Desneux, 1906)

RUDOLF H. SCHEFFRAHN
University of Florida, Fort Lauderdale Research & Education Center, 3205 College Avenue, Davie, Florida 33314 U.S.A.
rhsc@ufl.edu; *https://orcid.org/0000-0002-6191-5963*

Abstract

Amitermes californicus Banks, 1920 was described from southern California and southern Arizona but was later synonymized with *A. wheeleri* (Desneux, 1906) from Texas. Examination of material across the southwestern Nearctic and Mexico revealed that both are good species that are easily separated by the soldier mandibles. *Amitermes floridensis* Scheffrahn, 1989 is now a synonym of *A. wheeleri*. The establishment of *A. wheeleri* (=*floridensis*) in Florida is suggested to be the result of the ornamental palm trade from the southwestern United States. New collection records show that *A. wheeleri* has not been found in California.

Key words: Nearctic, Neotropical, mandibles, enteric valve armature

Introduction

The *Amitermes* termite group (*Amitermes* Silvestri and *Gnathamitermes* Light *sensu* Noirot, 2001) contains species that are important cellulosic decomposers in the soils of arid and semiarid Nearctic ecosystems (Johnson & Whitford 1975, Whitford 1999). The first Nearctic *Amitermes*, *A. wheeleri*, was verbally described by Desneux (1906) from soldiers and workers collected by W. M. Wheeler in Belton, Texas. *Amitermes wheeleri* has been, by far, the most studied species of the group both in terms of its role in grassland ecosystems (Ettershank *et al.* 1980, Haverty & Nutting 1975, Haverty *et al.* 1976, and Taylor *et al.* 1998) and its chemical defenses (Scheffrahn *et al.* 1983, Scheffrahn *et al.* 1986a, Scheffrahn *et al.* 1986b). A second related species, *A. californicus* Banks, 1920, was described from southern California and southern Arizona. Light (1930a) had originally misidentified *A. wheeleri* as an undescribed species that he would later describe as *Amitermes minimus* Light, 1932 while continuing to recognize *A. californicus*. Without discussion, Light (1931, 1932) synonymized *A. californicus* with *A. wheeleri* and this synonymy has gone unchallenged until now.

In 1989, I described *Amitermes floridensis* from Florida (Scheffrahn *et al.* 1989) with the diagnosis stating: "Mandible dentition can be used to categorize the Nearctic and Neotropical *Amitermes* soldiers into two convenient groups: those with marginal teeth directed perpendicular from the surface of the inner edge of the mandible and having a distinct anterior face, and those whose teeth are directed posterior and lack a well-defined anterior face (e.g., *A. emersoni* Light). The former group includes *A. wheeleri* (Desneux), *A. excellens* Silvestri, *A. brevicorniger* Silvestri, *A. amifer* Silvestri, and *A. foreli* Wasmann. Of these, *A. floridensis* most closely resembles *A. wheeleri* in mandibular structure and overall size; however, mandibles are shorter and stouter in the larger *A. wheeleri* soldiers". At that time, the only "*A. wheeleri*" soldiers I had available for comparison were collected by me in southern California. About ten years ago, I reviewed *Amitermes* soldiers that I and colleagues had collected in California, Arizona, New Mexico, and Texas over a period of 30 years. It became evident that there were two discernible species both having robust anterior faces on the marginal teeth of the mandibles. When comparing these two species to *A. floridensis*, I found that one was conspecific with *A. floridensis*. Herein, on the basis of soldier morphology, I restore *A. californicus* to full species status and I synonymize *A. floridensis* with *A. wheeleri*.

Accepted by L. Vidlicka: 7 Apr. 2022; published: 22 Apr. 2022

Material and methods

The distribution map (Fig. 1) was created from sample localities in the University of Florida Termite Collection (UFTC) database (Scheffrahn 2019, Table S1) and localities from Banks 1920, Light 1930a, Light 1930b, and Nickle & Collins 1988. Measurements (Fig. 2) were obtained using an Olympus SZH stereomicroscope fitted with an ocular micrometer. Preserved soldiers (Figs 3–5), stored in 85% ethanol, were positioned in a transparent petri dish filled with Purell® hand sanitizer (70% EtOH) and photographed as multi-layer montages using a Leica M205C stereomicroscope with a Leica DFC 425 module run with Leica Application Suite software version 3. Enteric valve armatures (Fig. 5) were mounted on slides with PVA mounting medium (Bioquip Products, Inc.) and photographed with a Leica CTR 5500 compound microscope using bright field lighting and the same montage software.

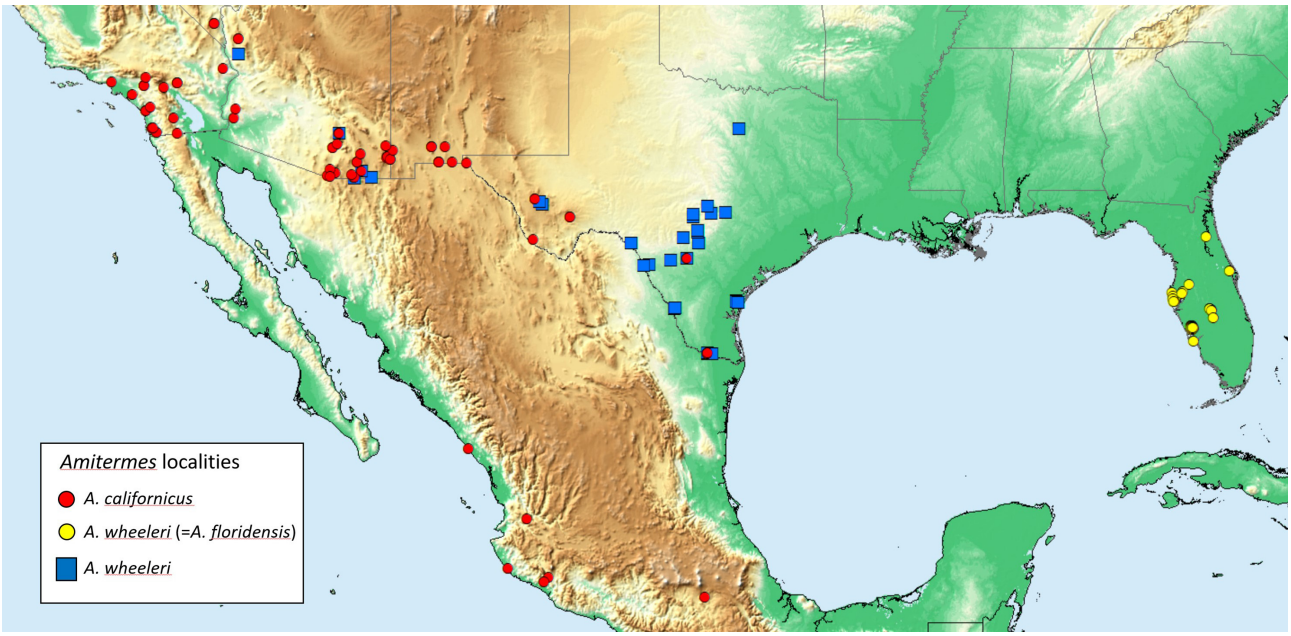

FIGURE 1. Distribution of *Amitermes californicus* and *A. wheeleri* from the University of Florida Termite Collection and literature records.

Taxonomy

Amitermes californicus Banks, 1920—revalidated name

Banks 1920: soldier described and figured; 61 fig. 2, 62, fig. 2.
Light 1930a: soldier, worker described and figured; 179, 184–187, 185, figs. L–O; pl. 11, fig. 1; pl. 12 figs. 1, 6; pl. 13, figs. 1, 5.
Light 1930b: soldier mandibles figured; 231 fig. 3.
Light 1931: 9; synonymized with *A. wheeleri*.
Light 1932: soldier figured, 363; synonymized with *A. wheeleri*.
Light 1934: soldier figured; 202 fig. d, g.
Weesner 1965: soldier figured; 61 fig. 19E.
Scheffrahn *et al.* 1983: soldier figured; 1297 fig. 1.
Scheffrahn *et al.* 1986a: soldier figured,662 fig. 1 (left).
Scheffrahn *et al.* 1986b: defensive secretion.
Nickle & Collins 1988: soldier, worker figured; pl. 7 fig G–H.
Krishna *et al.* 2013: 2061.

Imago. Unknown.

Soldier. (Figs. 2A, B; 3A). The descriptions by Banks (1920) and Light (1930a) are complimentary but lacking the following additional characters: In dorsal view, head capsule orange yellow; if full of secretion, cephalic gland light yellow; occupying about half of head capsule area. Fontanelle forms narrow arch in middle of frons, surrounded by dense mat of long setae. Labrum conical, well delineated from postclypeus. Mandibles dark reddish

brown from tips of blades to marginal teeth, bases massive with weak lateral humps. Blades broad beyond marginal teeth, then narrowing and curving evenly to tips. Marginal teeth large, subtriangular, and blunt. In lateral view, head capsule ovoid, bulbus; submentum projecting, parallel with ventral margin of head capsule. Dorsal margin with dozens of long setae; denser around fontanelle. Anterior margin of fontanelle forming shallow crease on frons. Anterior lobe of pronotum slightly longer than posterior lobe; pronotum margins with long setae.

Measurements. Fig. 1 and Table 1.

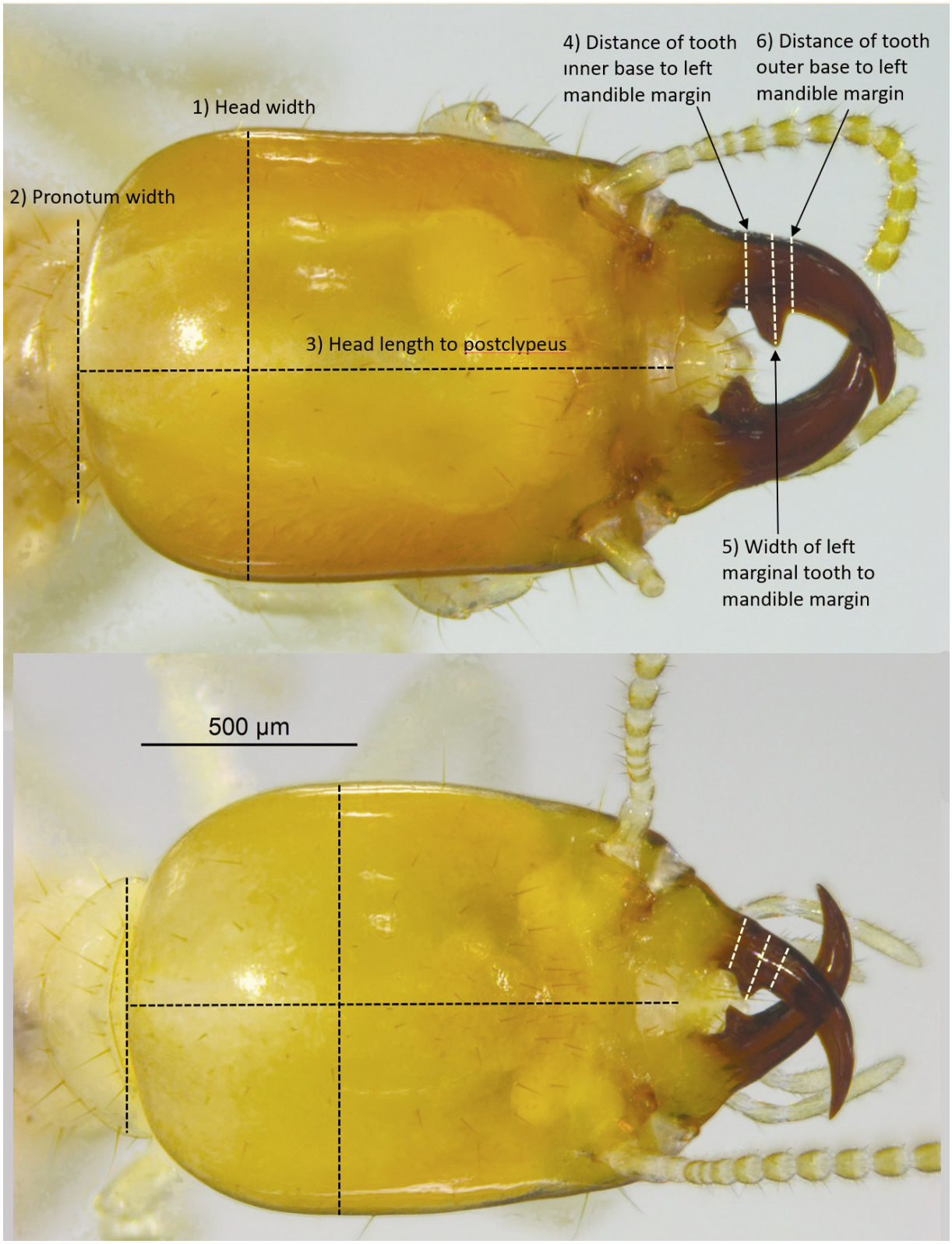

FIGURE 2. Measurements (Table 1) used to compare soldiers of *Amitermes californicus* (top) and *A. wheeleri* (bottom).

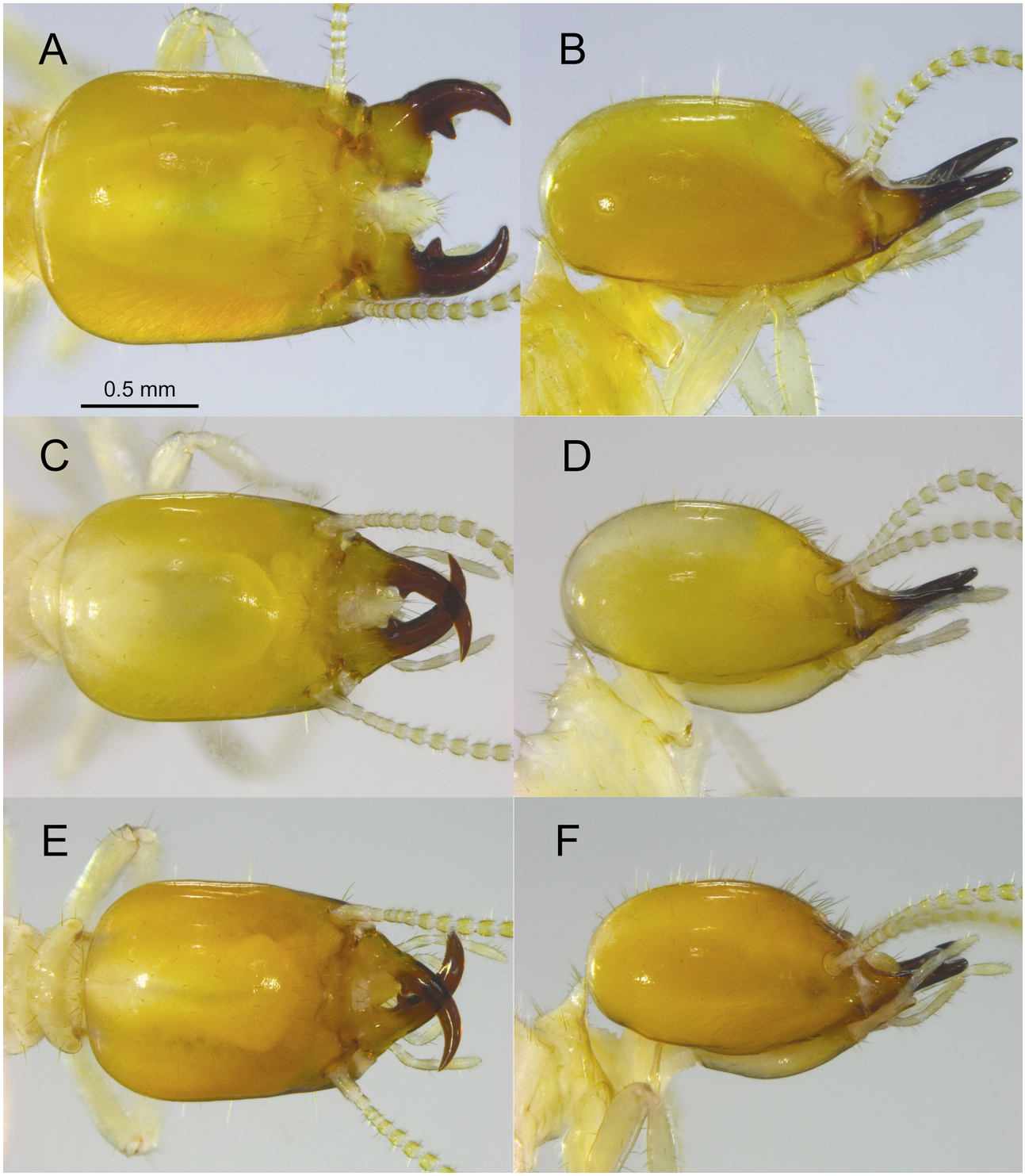

FIGURE 3. *Amitermes* soldier head capsules, dorsal view: **A, B**. *A. californicus* from Twenty Nine Palms, California; **C, D**. *A. wheeleri* from Corpus Christi, Texas; **E, F**. *A. wheeleri* from St. Petersburg, Florida.

Diagnosis. Among Nearctic *Amitermes*, the soldier of *A. californicus* most closely resembles that of *A. wheeleri* (=*floridensis*). The mandible bases, blades, and marginal teeth of *A. californicus* are larger and stouter in all respect than those of *A. wheeleri* (=*floridensis*) (Figs 2–5, Table 1). The soldier of *A. californicus* is somewhat larger and has a more quadrate head capsule than that of *A. wheeleri* (=*floridensis*).

Worker. The description by Light (1930a) is adequate but lacking the following additional characters: The second proctodeal segment (P2) very narrow and tubular; seating consists of circular flare connecting to the third proctodeal segment. Enteric valve armature (Fig. 5A) with six cushions extending length of P2; posterior ends of

cushion consisting of ovoid patches of pointy scales varying in number from about 25 to about eight. The cushion with the most posterior scales has a string of single scales extending to its anterior where scales divide into two or three strings. Other cushions lack a string, but their anterior terminations have scale strings or scale patches. The cushion with the least number of scales is always opposite that with the greatest.

Diagnosis. The workers of *A. californicus* and *A wheeleri* can only be separated by the former's larger size and longer EVA (Fig. 5).

Material Examined. Supplementary Table S1.

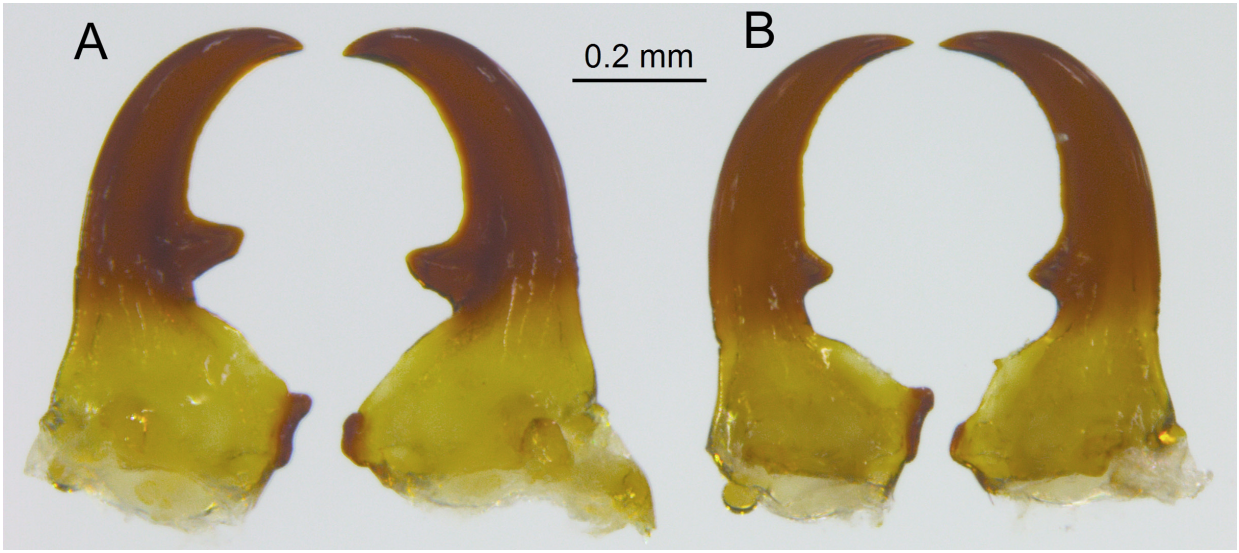

FIGURE 4. Dorsal view of *Amitermes* soldier mandibles: **A**, *A. californicus* from Pala, California; **B**, *A. wheeleri* from Pedernales Falls, Texas.

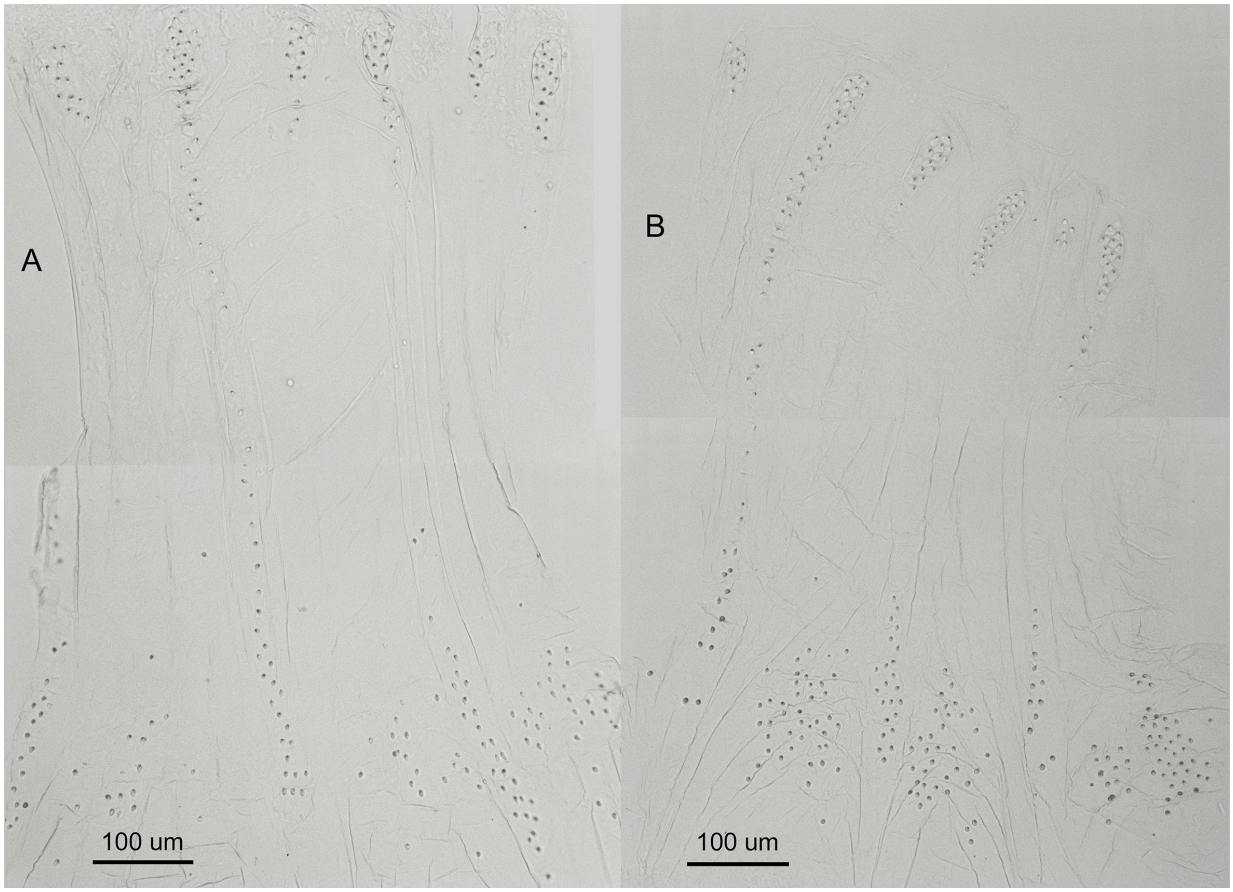

FIGURE 5. Worker enteric valve armature: **A**,. *A. californicus* from Madera Canyon, Arizona; **B,** *A. wheeleri* from Boerne, Texas.

TABLE 1. Measurements (mm) of *Amitermes* soldiers.

	A. californicus			*A. wheeleri* U.S.			*A. wheeleri* FL		
Measurements (Fig. 2)	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1) Head width	1.18	0.93	1.07	1.11	0.82	0.98	0.98	0.88	0.92
2) Pronotum width	0.7	0.56	0.64	0.67	0.51	0.59	0.6	0.49	0.53
3) Head length to postclypeus	1.49	1.16	1.32	1.39	0.98	1.26	1.23	1.11	1.18
4) Distance of tooth inner base to left mand. margin	0.19	0.14	0.17	0.18	0.07	0.13	0.12	0.11	0.12
5) Width of left marginal tooth to mand. margin	0.28	0.21	0.24	0.26	0.14	0.18	0.18	0.14	0.16
6) Distance of tooth outer base to left mand. margin	0.18	0.12	0.15	0.18	0.11	0.12	0.11	0.11	0.11
Specimens/colonies	60/25			56/21			7/4		

*Additonal measurements in Scheffrahn *et al.* 1989.

Amitermes wheeleri (Desneux, 1906)

Light, 1930b: soldier mandibles figured 231 fig. 4.
Nutting 1990: soldier figured 1019 fig. 33.15b.
Scheffrahn *et al.* 1983: soldier figured; 1297 fig. 1.
Scheffrahn *et al.* 1986a: soldier figured; 662 fig. 1 (right).
Scheffrahn *et al.* 1989: soldier figured; 619 fig. 1.
Scheffrahn & Su 1994: soldier figured; 468 figs. 22–23.
Krishna *et al.* 2013: 2061–2062.
Amitermes floridensis Scheffrahn, Su, Mangold, 1989 **syn. nov.**

A key that includes the soldiers of Nearctic species of *Amitermes* was published by Nutting (1990) beginning with couplet 9a (*A. wheeleri*). This key did not include *A. floridensis*. In order to accommodate *A. californicus*, couplet 9a must be modified and another couplet (10) added as follows:

9a (8a) Teeth large, conical, directed inward **10**
9b Teeth acute, cut out of margin and set off from basal hump by deep notch **11**
10a (9a) Mandible blades and teeth stout, mean head width ca. 1.07 mm (Figs. 3A, B, herein); common in the arid lands of the southwestern U.S. and Mexico . . . . . ***A. californicus*** Banks
10b Mandible blades and teeth slender, mean head width ca. 0.85 mm (Figs. 3C–F, herein); common in the arid lands of the southwestern U.S., Mexico, and mesic central Florida but may be absent or rare in California. . . . . ***A. wheeleri*** Light

The numbers for each succeeding couplet must be increased by one to complete the key.

Discussion

Light's 1930a redescription of *A. californicus* included a photograph of the mandibles from material collected in southern California that agreed with the illustration of *A. californicus* given by Banks 1906 as well as photographs herein (Fig. 3A). Light 1930b provided the same photograph from Light 1930a labelling it: "*Amitermes californicus* Banks, short, heavy type common in California". Light 1930a also included a previously unpublished photograph labelled "*Amitermes californicus* Banks, longer, slender type common in colonies from west coast of Mexico" which agrees with the mandibles of *A. wheeleri* as presented herein (Figs 3A, B; Fig. 4A). Light 1932b also confused *A. wheeleri* with his *A. minimus* Light, 1932a. Later, Light (1932a, 1934) only presented the photograph of his *A. californicus* "short heavy type" which he now called *A. wheeleri* while omitting the photo of his *A. californicus* "longer, slender type from Light 1930b. Light (1932) ascertained that Desneux's 1906 description of *A. wheeleri* is the same species as Banks' 1920 description of *A. californicus* even though Desneux 1920 gave no illustrations and described the soldier mandibles of *A. wheeleri* as being "quite short", "about half the length of the head", and

"strongly arched" which describes both species herein (Fig. 4) . Finally, Light (1932) concluded that there was only a single species of North American *Amitermes* in which the marginal teeth of the soldier mandibles have an anterior margin even though Light 1930b showed striking differences between his two *A. californicus* forms. Scheffrahn *et al.* 1983 identified the soldier defensive secretion of what I thought at the time were *A. wheeleri* colonies collected in southern California. My drawing, therein, of the soldier head capsule and mandibles (Scheffrahn *et al.* 1983, fig. 1) matches that of *A. californicus* as redescribed herein. New collection records (Fig. 1, Table S1) show that *A. wheeleri* has not been recorded from California.

I had originally thought that it was unlikely that *A. wheeleri* (=*floridensis*) was introduced by anthropogenic means (Scheffrahn *et al.* 1989) because I was unaware that *A. floridensis* was a synonym of *A. wheeleri* so I surmised *A. floridensis* was a relict *Amitermes* species of an expanded ancient Nearctic distribution. Now I conclude that the introduction of *A. wheeleri* (=*floridensis*) to Florida is most likely associated with the importation of palms from nurseries in the southwestern United States. *Washintonia robusta*, the Mexican fan palm, has been widely cultivated along the Gulf Coast from Texas to Florida. Beginning in 1900, date palms, *Phoenix dactylifera*, were cultivated in California and Arizona, and although not grown for fruit in Florida, were commonly imported there as landscape plants (Bomhard 1950). I have collected colonies of *Amitermes* in date palm groves near Indio and Thermal, California, where they forage on dead palm roots and fallen fronds.

Acknowledgments

I thank Jim Chase and John Mangold for contributing greatly to the *Amitermes* samples in the UFTC.

References

Banks, N. & Snyder, T.E. (1920) A revision of the Nearctic termites, with notes on the biology and distribution of termites. *United States National Museum Bulletin*, 108, 1–85.
https://doi.org/10.5479/si.03629236.108.i

Bomhard, M.L. (1950) *Palm trees in the United States. No. 22*. US Department of Agriculture, Forest Service, Washington, D.C., 26 pp.

Desneux, J. (1906) Variétés termitologiques. *Annales de la Société Entomologique de Belgique*, 49, 336–360.

Ettershank, G., Ettershank, J.A. & Whitford, W.G. (1980) Location of food sources by subterranean termites. *Environmental Entomology*, 9, 645–648.
https://doi.org/10.1093/ee/9.5.645

Haverty, M.I. & Nutting, W.L. (1975) Density, dispersion, and composition of desert termite foraging populations and their relationship to superficial dead wood. *Environmental Entomology*, 4, 480–486.
https://doi.org/10.1093/ee/4.3.480

Haverty, M.I., Nutting, W.L. & Lafage, J.P. (1976) A comparison of two techniques for determining abundance of subterranean termites in an Arizona desert grassland. *Insectes Sociaux*, 23, 175–178.
https://doi.org/10.1007/BF02223850

Johnson, K.A. & Whitford, W.G. (1975) Foraging ecology and relative importance of subterranean termites in Chihuahuan Desert ecosystems. *Environmental Entomology*, 4, 66–70.
https://doi.org/10.1093/ee/4.1.66

Krishna, K., Grimaldi, D.A., Krishna, V. & Engel, M.S. (2013) Treatise on the Isoptera of the world: Vol. 6. Termitidae. *Bulletin of the American Museum of Natural History*, 377, 1988–2432.
https://doi.org/10.1206/377.6

Light, S.F. (1930a) The California species of the genus *Amitermes* Silvestri (Isoptera). *University of California Publications in Entomology*, 5, 173–214.

Light, S.F. (1930b) The Mexican species of *Amitermes* Silvestri (Isoptera). *University of California Publications in Entomology*, 5, 215–233.

Light, S.F. (1931) The termites of Nevada. *Pan-Pacific Entomologist*, 8, 5–9.

Light, S.F. (1932) Contribution toward a revision of the American species of *Amitermes* Silvestri. *University of California Publications in Entomology*, 5, 355–414.

Light, S.F. (1934) The desert termites of the genus *Amitermes*. *In*: Kofoid, C.A. (Ed.) *Termites and Termite Control. 2nd Edition*. University of California Press, Berkeley, California, pp. 199–205.

Nickle, D.A. & Collins, M.S. (1988) The termite fauna (Isoptera) in the vicinity of Chamela, State of Jalisco, Mexico. *Folia Entomológica Mexicana*, 77, 85–122.

Noirot, C. (2001) The gut of termites (Isoptera). Comparative anatomy, systematics, phylogeny. II. Higher termites (Termitidae). *Annales de la Société Entomologique de France*, 37, 431–471.
Nutting, W.L. (1990) Insecta: Isoptera. *In*: Dindal, D.L (Ed.), *Soil Biology Guide*. John Wiley & Sons, New York, New York, pp. 997–1032.
Scheffrahn, R.H. (2019) University of Florida Termite Collection (UFTC). Available from: https://www.termitediversity.org/ (accessed 30 September 2021)
Scheffrahn, R.H., Gaston, L.K., Sims, J.J. & Rust, M.K. (1983) Identification of the defensive secretion from soldiers of the North American termite, *Amitermes wheeleri* (Desneux) (Isoptera: Termitidae). *Journal of Chemical Ecology*, 9, 1293–1305.
https://doi.org/10.1007/BF00994798
Scheffrahn, R.H., Gaston, L.K., Nutting, W.L. & Rust, M.K. (1986a) Chemical heterogeneity of soldier defensive secretions in the desert subterranean termite, *Amitermes wheeleri*. *Biochemical Systematics and Ecology*, 14, 661–664.
https://doi.org/10.1016/0305-1978(86)90049-9
Scheffrahn, R.H., Sims, J.J., Lee, R K. & Rust, M.K. (1986b) Helminthogermacrene, a major component in the defensive secretion of the Nearctic termite, *Amitermes wheeleri*. *Journal of Natural Products*, 49, 699–701.
https://doi.org/10.1021/np50046a028
Scheffrahn, R.H., Su, N.-Y. & Mangold, J.R. (1989) *Amitermes floridensis*, a new species and first record of a higher termite in the eastern United States (Isoptera: Termitidae: Termitinae). *Florida Entomologist*, 72, 618–625.
https://doi.org/10.2307/3495036
Scheffrahn, R.H. & Su, N.-Y. (1994) Keys to soldier and winged adult termites (Isoptera) of Florida. *Florida Entomologist*, 77, 460-474.
https://doi.org/10.2307/3495700
Taylor, H.S., MacKay, W.P., Herrick, J.E., Guerrero, R.A. & Whitford, W.G. (1998) Comparison of field methods to detect termite activity in the Northern Chihuahuan Desert (Isoptera). *Sociobiology*, 32, 1–16.
Weesner, F.M. (1965) *Termites of the United States: a handbook*. National Pest Control Association, Elizabeth, New Jersey, 70 pp.
Whitford, W.G. (1999) Activity of subterranean termites in arid southeastern New Mexico (lsoptera). *Sociobiology*, 34, 493–504.