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Original article

Taxonomy and distribution of termite fauna (Isoptera) in Riyadh Province, the Kingdom of Saudi Arabia, with an updated list of termite species on the Arabian Peninsula

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ABSTRACT

The present study shows an updated synoptic list of the 30 known Isoptera of the Arabian Peninsula which are classified under four families and nine genera. Twenty-seven species are hitherto known from the Kingdom of Saudi Arabia (KSA). The present inventory of the termites of Riyadh Province (KSA) indicated three species, *Anacanthotermes ochraceous* (Burmeister 1839), *Psammotermes hypostoma* Desneux, 1902 and a rare species, *Coptotermes heimi* (Wasmann 1902). We present an illustrated key to species based on the soldier caste. *Anacanthotermes ochraceous*, and *P. hypostoma* are widely distributed Palearctic species whereas *C. heimi* seems rare and is a new record for KSA. Distribution maps for the three species are provided based on recently collected material and literature records and remarks on species habitat preference are given.

1. Introduction

Termites (Isoptera) are eusocial monophyletic insects (Legendre et al., 2008) composed of distinct castes including worker, soldier, reproductive, queen, and larva that are widely distributed in tropics and subtropics, where they can make up to 95% of the soil insect biomass (Eggleton et al., 1996; Bechly, 2007). Isoptera are closely related to the two other major lineages of Dictyoptera (Blattaria and Mantodea) (Inward et al., 2007; Engel et al., 2009) and it is thought to have evolved from cockroach-like ancestor 200 million years ago (Bechly, 2007; Djernæs et al., 2015). Phylogenetically, termites are separated into lower termites (Hodotermitidae, Kalotermitidae, Mastotermitidae, Rhinotermitidae, Serritermitidae, and Termopsidae) and higher termites (Termitidae) (Krishna et al., 2013). Of the over 2600 termite species worldwide, belonging to 290 genera within 12 families and 14 subfamilies, 183 species are known to damage buildings and 83 species cause significant damage to wooden structures (Edwards and Mill, 1986; Krishna et al., 2013). Termites can be grouped into four ecological types: drywood, damp wood, harvester, and subterranean termites (Nutting and Jones, 1990). Only the subterranean termites continued contact with soil to complement moisture requirements. Subterranean termites are responsible for 80% of the economically important species. Unlike drywood termites that are easily transported from region to region, most subterranean species are restricted in their native distribution (Su and Scheffrahn, 1998).

Riyadh Province of the Kingdom of Saudi Arabia (KSA) is located at the eastern part of the Najd Plateau, in the center of the an-Nafud desert and has an area of 404,240 km^2. The extensive urbanization projects coupled with reclamation have created a favorable environment for termite infestation (Faragalla and Al Qhtani, 2013). Recent surveys have shown that the number of termite species occurring in KSA have increased (Faragalla, 2002; Kaakeh,

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2006; Faragalla and Al Qhtani, 2013; Khan et al., 2018). However, few reports are available on the termites of Riyadh Province, with numerous misidentifications included. Taxonomy of termites is challenging due to ambiguities in their diagnostic morphological characters and crypto-biotic social structure (Evans, 2010). The morphology of termite is an essential key in identifying termite species. While the worker and reproductive castes are extremely similar among species, the soldier castes are useful for species recognition. The current molecular techniques are also useful for species identification.

The taxonomic history of the termite fauna of the Arabian Peninsula began with a faunal review of the termite species of KSA (Chhotani and Bose, 1979), recording five species, *Anacanthotermes ochraceous* (Burmeister, 1839), *Psammotermes hypostoma* Desneux, 1902, *Microtermes najdensis* Harris, 1964, *Microcerotermes buettikeri* Chhotani & Bose, 1979 and *Angulitermes arabiae* Chhotani and Bose, 1979 belonging to three families, Hodotermitidae, Rhinotermitidae and Tetrmitidae. *Microcerotermes buettikeri* and *A. arabiae* were described as new species. In addition, they provided a list of 18 species belonging to 11 genera and four families in the Arabian Peninsula. This study was followed by a series of treatments dealing with numerous aspects of the termite fauna of the KSA and the entire Arabian Peninsula including checklists, distribution records, zoogeography, ecology and molecular studies of some species (Nasr et al., 1978, 1980; Badawi et al., 1984a, 1984b, 1986a, b; Cowie 1989, Faragalla, 2002; Kaakeh, 2006; Faragalla and Al Qhtani, 2013; Khan et al., 2018). The termite fauna hitherto known from the Arabian Peninsula includes 22 species (Badawi et al., 1986a, b; Chhotani and Bose, 1979, 1982, 1991; Cowie, 1989; Kaakeh, 2005).

Termites have increasing become one of the most destructive pests (Wood and Sands, 1978; Faragalla, 1983; Faragalla, 1988) capable of reducing wooden structures to "dust" in KSA (Nasr et al., 1978, 1980; Su and Scheffrahn, 1990; Koehler et al., 1998). Therefore, we initiated a survey of the termites of Riyadh Province. An integral aspect of our study was to provide for the first time keys to the soldier caste of the termites of the Riyadh Province, assisting termite control strategies.

2. Material and methods

2.1. Sample collection

During the sampling more than 2000 termite specimens were collected from diverse habitats including drywood, damp wood, cartoon objects, dead wood of *Acacia, Calotropis*, *Tamarix*, imported wood, cartoons, woody building, dead date palm frond on wet soil, plywood, branch of live *Cypress* trees, and dead date palm trunk in 228 sites in Riyadh Province (Fig. 1). Surveyed sites in Riyadh Province and other sites, the KSA are shown in Fig. 1. The specimens/samples were collected by hand picking and using an aspirator. The specimens were taken to the Economic Entomology Research Unite (EERU), Plant Protection Department, College of Food and Agriculture Science, King Saud University, where they were sorted, mounted, identified, and conserved. The material was collected using aspirator and by hand picking, sorted, mounted, identified and preserved in the Economic Entomology Research Unite (EERU), Plant Protection Department, College of Food and Agriculture Science, King Saud University. Termite identification was made using Taxonomic identification of termite species is carried out using works of Chhotani and Bose (1979, 1982, 1991). Other unidentified termite species have been sorted to morpho-species. Species names in this work follow the termite online catalogue of Constantino (2020). Distribution maps were made using DIVA-GIS (version 7.5.0.0).

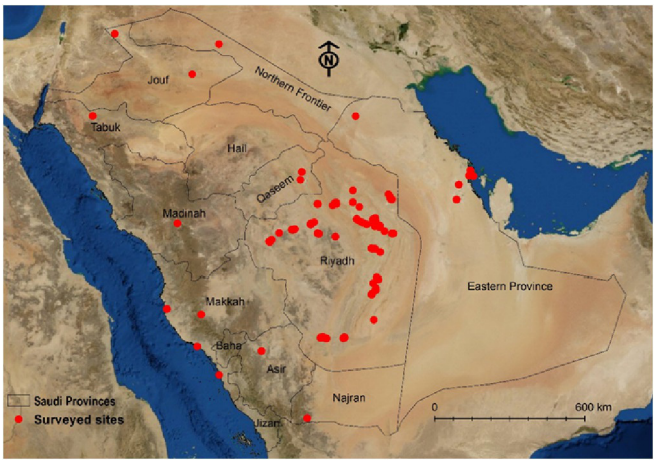

Fig. 1. Surveyed sites in Riyadh Province.

2.2. Abbreviation of museums

KSMA: King Saud University Museum of Arthropods, Plant Protection Department, College of Food and Agriculture Science, King Saud University, Riyadh, The Kingdom of Saudi Arabia. Throughout the work, "s" stands for soldier(s), "w" stands for worker(s), and SE for "sexual(s).

3. Results

3.1. Updated synoptic list of termite species in the Arabian Peninsula

Family Hodotermitidae
1. *Anacanthotermes ochraceus* (Burmeister, 1839)
2. *Anacanthotermes saudiensis* Chhotani & Bose, 1982
3. *Anacanthotermes ubachi* (Navás, 1911)
4. *Anacanthotermes vagans* (Hagen, 1858)

Family Kalotermitidae
Epicalotermes aethiopicus Silvestri, 1918

Family Rhinotermitidae
6. *Coptotermes heimi* (Wasmann, 1902)
7. *Psammotermes hybostoma* Desneux, 1902
8. *Heterotermes aethiopicus* (Sjöstedt, 1911)
9. *Heterotermes omanae* Chhotani, 1988
10. *Heterotermes wittmeri* Chhotani and Bose, 1982

Family Termitidae
11. *Amitermes gallagheri* Chhotani, 1988
12. *Amitermes messinae* (Fuller, 1922)
13. *Amitermes stephensoni* Harris, 1957
14. *Amitermes vilis* (Hagen, 1858)
15. *Angulitermes arabiae* Chhotani & Bose, 1979
16. *Angulitermes asirensis* Chhotani and Bose, 1991
17. *Angulitermes quadriceps* Harris, 1964
18. *Angulitermes truncatus* Sjöstedt, 1926
19. *Macrotermes subhyalinus* (Rambur, 1842)
20. *Microcerotermes buettikeri* Chhotani & Bose, 1979
21. *Microcerotermes diversus* Silvestri, 1920
22. *Microcerotermes gabrielis* Weidner, 1955
23. *Microcerotermes parvulus* (Sjöstedt, 1911)
24. *Microcerotermes sabaeus* (Harris, 1957)
25. *Microtermes najdensis* Harris, 1964
26. *Microtermes subhyalinus* Silvestri, 1914
27. *Microtermes yemenensis* Wood, Lamb & Bednarzik, 1986
28. *Mycterotermes meringocephalus* Sands, 1965
29. *Trinervitermes arabiae* Harris, 1957
30. *Trinervitermes saudiensis* Sands, 1965

3.2. Key to families of termites of KSA (Soldier caste)

Eyes pigmented; cerci large Hodotermitdae
- Eyes absent or unpigmented; cerci absent 2
Fontanelle present 3
- Fontanelle absent Kalotermitidae
Pronotum flat without anterior lobes Rhinotermitidae
-Pronotum saddle-shaped with anterior lobes Termitidae

3.3. Key to species collected in Riyadh Province (Soldier caste)

Large species, HL 3.08 or more; eyes present (Fig. 2A) *Anacanthotermes ochraceus*
- Smaller species, HL 2.12 or less; eyes absent 2
2.Mandibles with marginal teeth, left mandible with a terminal tooth and 3 marginal teeth, right mandible with a terminal tooth and two marginal teeth only (Fig. 2B); number of antennal segments 16–17 (Fig. 2B); labrum well-developed extending anteriorly to half-length of mandible (Fig. 2B) *Psammotermes hybostoma*
- Mandibles without marginal teeth (Fig. 2C); number of antennal segments 13; labrum small concealing about one fourth of mandible length (Fig. 2C) *Coptotermes heimi*

3.4. Family Hodotermitidae

Members of this family feed on damp wood, with a single exception (subfamily Hodotermitinae or harvester termites), which feed on vegetation. Species of this family forage above ground. They are easily separable from other termites by the well-developed eyes. The geographic occurrence ranges from the Palaearctic Region through North Africa, the East African savannas to southern Africa.

Anacanthotermes ochraceus (Burmeister)

Termes ochraceus Burmeister, 1839: 765 (imago).

Type data: Lectotype: RIB imago Paralectotypes: ZMB imago Egypt, MCZ No. 10,108 imagoes.

Lectotype designation: Mathot, 1979: 9 [inadvertent selection by inference of "holotype" (ICZN, 1999, art. 74.6)].

Type locality: Egypt.

Zoogeographical Regions: Afrotropic; Palearctic.

Material examined. KSA, Riyadh Province: Dirab: Agricultural research and experimental station, 24°25.094′N, 46°39.093′E, 561 m, 16.xii.2020, (4 w); Agricultural research and experimental station, 24°25.322′N, 46°39.183′E, 560 m, 16.xii.2020, (Al Ansi, A., Omar, O. and Sotanto, K.) (2 w, 2 s); **Al Muzahmiyah**: Dirab-Durma Rd., Qusor Al Moqbel, 24°29.502′N, 46°22.157′E, 609 m, 22.xii.2020, (3 w); **Al Hair:** Dirab-Al Hair Rd., 5 km to Al Hair, 24°23.690′N, 46°48.073′E, 478 m, 20.xii.2020, (2 w); Al Hair, in front of Al Hair station, 24°23.639′N, 46°49.737′E, 540 m, 20.xii.2020, (6 w); Al Hair, in front of Al Hair park, 24°25.356′N, 46°50.054′E, 529 m, 20.xii.2020, (3 w); Dhurma, Dhurma-Ath Tharmida Rd., 15 km out Dhurma, 24°40.896′N, 46°00.367′E, 657 m, 22.xii.2020, VC, (3 w); Dhurma, 24°40.894′N, 46°00.364′E, 653 m, 22.xii.2020, (6 w); Dhurma, 24°39.966′N, 46°00.465′E, 651 m, 22.xii.2020, (4 w); **Al Dwadmi:** near to Al Zamil palace, Al Najashy, 24°28.887′N, 44°21.540′E, 978 m, 13.i.2021, (3 w); Al Dwadmi-Al Bijadyah Rd., 24°28.791′N, 44°20.891′E, 997 m, 13.i.2021, (3 w); Al Dwadmi-Al Bijadyah Rd., 24°28.805′N, 44°20.881′E, 991 m, 13.i.2021, (3 w); Al Dwadmi-Al Bijadyah Rd., 24°28.806′N, 44°20.881′E, 989 m, 13.i.2021, (3 w); Al Dwadmi, Mushrifah, Hantosh farm, (Mohammed Al Haji), 24°28.701′N, 44°21.178′E, 989 m, 13.i.2021, (4 w); Al Dwadmi, Mushrifah, Hantosh farm, (Mohammed Al Haji), 24°28.726′N, 44°21.207′E, 986 m, 13.i.2021, (4 w); Al Dwadmi, Near to Al Zamil palace, Al Najashy, 24°28.887′N, 44°21.555′E, 990 m, 13.i.2021, (3 w); **Sajir:** Sajir-Al Sakran Rd., 25°12.645′N, 44°36.095′E, 711 m, 14.i.2021, (4 w); Sajir,

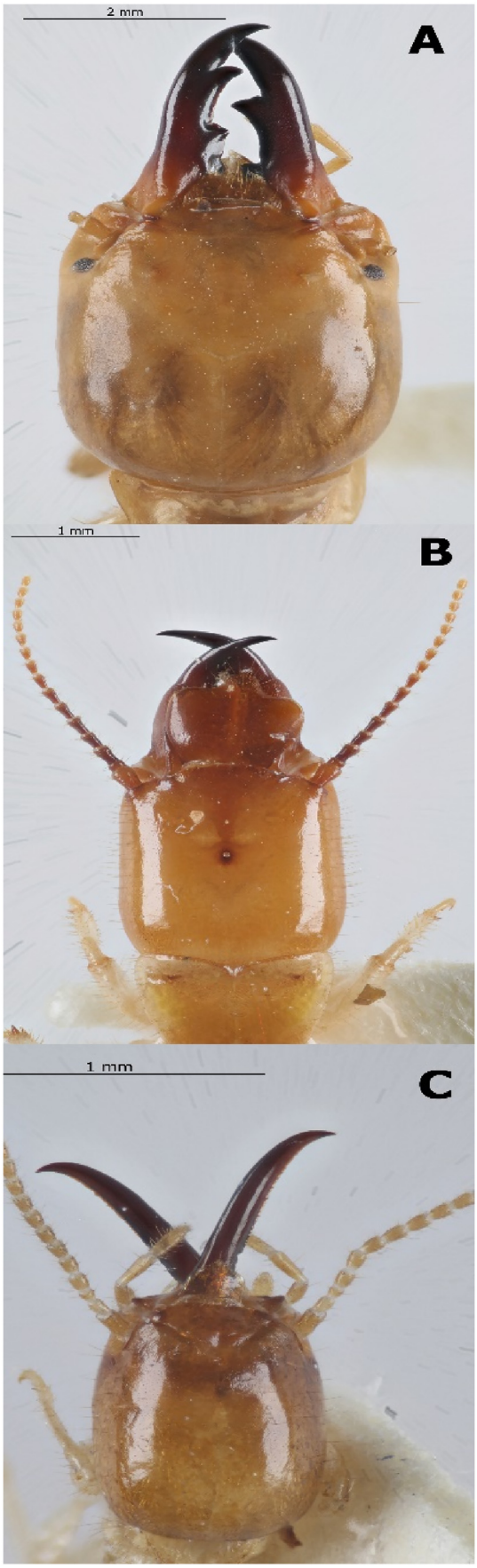

Fig. 2. Key illustrations, A–C Head in full-face view of soldier, A: Anacanthotermes ochraceous; B: Psammotermes hypostoma; C: Coptotermes heimi.

Al Sakran-Sajir Rd., near Naqiah center for cereal & sheep foods, 25°13.306′N, 44°35.827′E, 708 m, 14.i.2021, (4 w); Sajir, Al Sakran-Sajir Rd., 25°13.332′N, 44°35.856′E, 709 m, 14.i.2021, (4 w); Sajir, near King Abdulaziz park, 24°09.895′N, 44°36.009′E, 721 m, 14.i.2021, (4 w); Sajir, near King Abdulaziz park, 24°09.878′N, 44°36.022′E, 722 m, 14.i.2021, (4 w); Sajir, near King Abdulaziz park, 24°09.879′N, 44°36.009′E, 726 m, 14.i.2021, (3 w, 1 s); **Al Bijadyah:** 24°17.937′N, 43°44.232′E, 912 m, 12.i.2021, (3 w); Al Dwadmi-Al Bijadyah Rd., 24°17.787′N, 43°43.596′E, 927 m, 12.i.2021, (2 w, 1 s); Al Qaseemah, 24°18.335′N, 43°44.296′E, 896 m, 12.i.2021, (3 w); Al Qaseemah, 24°18.334′N, 43°44.294′E, 928 m, 12.i.2021, (3 w); Al Qaseemah, Abdullah Al Gomayaie farm, 24°18.331′N, 43°44.286′E, 912 m, 12.i.2021, (1 w); Al Bijadyah-Al Dwadmi Rd., near Al bajadiah ambulance center, 24°18.853′N, 43°47.018′E, 902 m, 12.i.2021, (3 w); Al Bijadyah-Al Dwadmi Rd., 24°18.441′N, 43°47.018′E, 912 m, 12.i.2021, (3 w); Al Dwadmi-Al Bijadyah Rd., 24°17.783′N, 43°43.584′E, 924 m, 12.i.2021, (3 w); Al Bijadyah-Afif Rd., 24°17.804′N, 43°43.625′E, 923 m, 12.i.2021, (3 w); Al Bijadyah-Afif Rd., 24°17.782′N, 43°43.614′E, 921 m, 12.i.2021, (2 w, 3 s); **Afif:** Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.377′N, 42°57.458′E, 1059 m, 11.i.2021, (2 w); Afif-Dhalam Rd., 23°51.859′N, 42°53.579′E, 1019 m, 11.i.2021, (3 w); Afif-Dhalam Rd., 23°51.837′N, 42°53.568′E, 1021 m, 11.i.2021, (3 w, 2 s); **Shaqraa:** Ar Rahabah neighborhood, 25°15.686′N, 45°14.216′E, 709 m, 15.i.2021, (4 w); Al Qrain, 25°13.278′N, 45°16.760′E, 697 m, 15.i.2021, (4 w); **Hawtet bani Tamim:** Hareeq-Al Mofaiger Rd., 23°36.809′N, 46°33.434′E, 654 m, 8.i.2021, (3 w, 1 s); Hawtet bani Tamim, Naam Rd., 23°36.752′N, 46°39.265′E, 608 m, 8.i.2021, (3 w); **Al Aflg:** Al Badie, As Sulayyil- Al Aflag Rd., 21°59.719′N, 46°32.657′E, 537 m, 7.i.2021, (2 w, 1 s); **As Sulayyil:** Al Riggah, 20°28.153′N, 45°33.761′E, 594 m, 6.i.2021, (3 w); Al Riggah, 20°27.881′N, 45°33.305′E, 593 m, 6.i.2021, (5 w); Al Riggah, 20°27.903′N, 45°33.324′E, 589 m, 6.i.2021, (6 w); As Sulayyil, 20°26.063′N, 45°31.302′E, 573 m, 6.i.2021, (3 w); As Sulayyil, 20°26.082′N, 45°31.332′E, 575 m, 6.i.2021, (3 w). All specimens are collected by Al Ansi & Sotanto using by handpicking and aspirator (KSMA).

Local distribution. This species occurs widely throughout the various regions of KSA, while it has a limited occurrence in the southwestern mountains (Chhotani and Bose, 1979, Nasr et al., 1978, 1980; Badawi et al., 1986b) (Fig. 3).

Geographic range. A well-known Palearctic species that is wide-spread in the arid regions of North Africa, the Middle East, the Arabian Peninsula (Kuwait, Oman, Qatar, Saudi Arabia), Iraq, Iran, Afghanistan (Cowie1989), and Sudan (Sjostedt 1925; Harris 1968; Pearce et al., 1986).

Foraging/feeding substrate. The feeding and nesting habits of *A. ochraceus* is diverse including dead wood, dead date palm fronds, imported wood, dry grass, cartoon bags, dead *Acacia, camphora*, *Cinnamomum* and Tamarix, and sheep dung.

3.5. Family Rhinotermitidae (subterranean termites)

Species of this family build nests underground in moist soil, in buried wood or in wood lying on the ground.

Coptotermes heimi (Wasmann, 1902)

Arrhinotermes heimi Wasmann, 1902d: 104 (imago), pl. 4: Fig. 1 [described as "Heimi"; synonym of *gestroi* fide Yeap et al., 2010; Junior Subjective Synonym of *Coptotermes parvulus* Holmgren, 1913: 104].

Type data: Syntypes: AMNH imagoes, NHMM imagoes, USNM imago.

Type locality: India: Maharashtra: Ahmadnagar District: Wallon.

Zoogeographical Regions: Palearctic, Oriental.

Material examined. KSA, Riyadh Province: Al Aflg: Al Badie Al Shemali, 22°01.933′N, 46°33.794′E, 547 m, 7.i.2021, (3 w); Al Badie Al Shemali, Al Hadar Rd., 22°00.395′N, 46°31.972′E, 547 m, 7.i.2021, (2 w, 2 s); Al Badie Al Shemali, Al Hadar Rd., 22°00.399′N, 46°31.983′E, 536 m, 7.i.2021, (5 w); Al Badie Al Shemali, Al Hadar Rd., 22°00.398′N, 46°31.974′E, 538 m, 7.i.2021, (3 w); Al Badie Al Shemali, Al Hadar Rd., 22°00.398′N, 46°31.985′E, 538 m, 7.i.2021, (3 w); Al Badie Al Shemali, Al Hadar Rd., 22°00.388′N, 46°31.989′E, 538 m, 7.i.2021, (2 w, 1 s); Al Badie Al Shemali, Al Hadar Rd., 22°00.390′N, 46°31.985′E, 545 m, 7.i.2021, (2 w, 1 s); **Hawtet bani Tamim**: Naam-Al Hareeq Rd.,Naam park, 23°36.426′N, 46°39.917′E, 626 m, 8.i.2021, (5 w); Naam, 23°37.267′N, 46°38.028′E, 617 m, 8.i.2021, (3 w, 2 s); Al Hareeq,

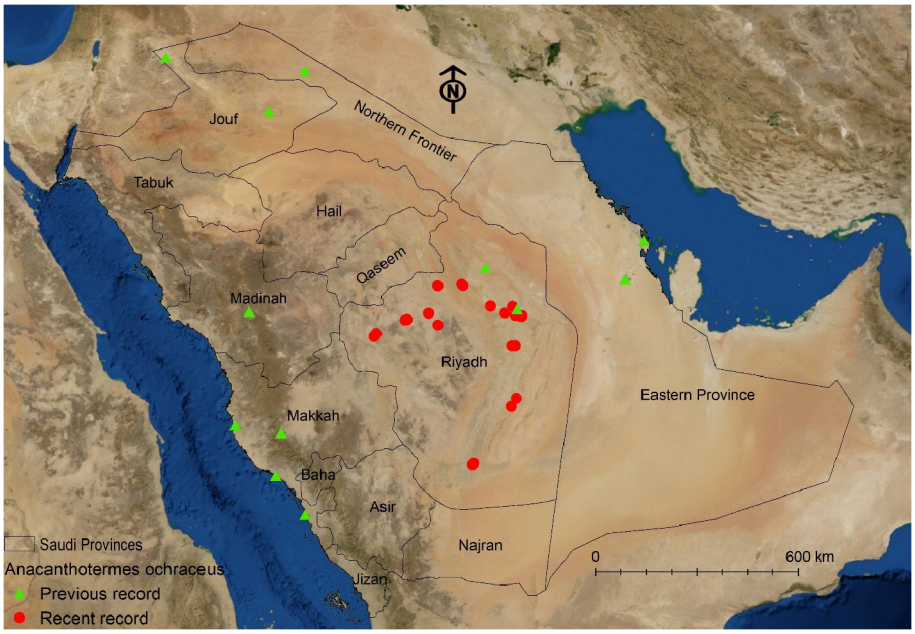

Fig. 3. Distribution map of *Anacanthotermes ochraceous*.

23°37.807′N, 46°31.786′E, 654 m, 8.i.2021, (3 w, 1 s); Al Hareeq, 23°37.814′N, 46°31.786′E, 675 m, 8.i.2021, (3 w); Naam Rd., 23°36.759′N, 46°39.260′E, 624 m, 8.i.2021, (3 w); **Wadi Ad Dawasir:** Khamis Mushait Rd., 20°27.331′N, 44°43.188′E, 685 m, 5.i.2021, (5 w); Wadi Ad Dawasir- Khamis Mushait Rd., 20°27.345′N, 44°43.213′E, 686 m, 5.i.2021, (6 w); Wadi Ad Dawasir- Khamis Mushait Rd., 20°27.608′N, 44°43.583′E, 679 m, 5.i.2021, (4 w, 1 s). All specimens are collected by Al Ansi & Sotanto using by handpicking and aspirator (KSMA).

Geographic range. Bangladesh, Bhutan, India, Indonesia, Nepal, Oman, Pakistan, UAE. This species is recorded for the first time from the KSA (Fig. 4).

Foraging/feeding substrate. This species was found nesting in dead wood of *Acacia,* and *Tamarix,* plywood, imported wood, dead date palm trunk and date palm fronds.

Psammotermes hybostoma Desneux, 1902

Psammotermes hybostoma Desneux, 1902: 437–440 (major, minor soldier), Fig. 1.

Type data: Syntypes: NHRM soldiers (Algeria: Biskra), AMNH soldier (Algeria: Biskra), NHRM soldiers (Algeria: Souf, between Maouiet-Ferzan and Tougourt), NHMM soldier, worker (Algeria: Biskra), NHMM worker (Algeria: Souf, El Qued-Tougourt).

Type Localities: Algeria: Biskra, Souf, between Maouiet-Ferzan and Tougourt.

Zoogeographical Regions: Afrotropic; Palearctic.

Material examined. KSA, Riyadh Province: Rawdhet Khoraim: 25°23.176′N, 47°16.270′E, 542 m, 28.xii.2020, (5 w); Rawdhet Khoraim, 25°23.228′N, 47°16.665′E, 544 m, 28.xii.2020, (5 w); Rawdhet Khoraim, 25°23.006′N, 47°16.3613′E, 539 m, 28.xii.2020, (7 w, 1 s); Shuaib Ghaylanah., 25°24.145′N, 47°12.618′E, 546 m, 28.xii.2020, (2 w, 9 s); Shuaib Ghaylanah, 25°24.145′N, 47°12.625′E, 547 m, 28.xii.2020, (3 w, 3 s); Rawdhet Khoraim, 25°26.096′N, 47°12.833′E, 544 m, 28.xii.2020, (2 w, 6 s); Rawdhet Khoraim, 25°26.069′N, 47°12.846′E, 547 m, 28.xii.2020, (6 w); Rawdhet Khoraim, 25°26.017′N, 47°12.911′E, 537 m, 28.xii.2020, (2 w, 5 s); Rawdhet Khoraim, 25°26.833′N, 47°12.389′E, 539 m, 28.xii.2020, (3 w, 1 s); Rumah, 25°30.581′N, 47°11.329′E, 547 m, 28.xii.2020, (3 w, 4 s); Rumah, 25°34.367′N, 47°08.566′E, 549 m, 28.xii.2020, (5 w, 1 s); KSA: Rumah, 25°34.356′N, 47°08.560′E, 557 m, 28.xii.2020, (3 w, 3 s); **Dirab:** Agricultural research and experimental station, 24°25.090′N, 46°39.498′E, 561 m, 16.xii.2020, Al Ansi, A., Omar, A. & Sotanto, K. (4 w, 5 s); Agricultural research and experimental station, 24°24.674′N, 46°39.312′E, 563 m, 16.xii.2020, (Al Ansi, A., Omar, A. & Sotanto, K.), (1 w, 4 s); Agricultural research and experimental station, 24°25.086′N, 46°39.092′E, 560 m, 16.xii.2020, (Al Ansi, A., Omar, A. & Sotanto, K.), (5 w); **Al-Muzahmiya**: Dirab-Dhurma Rd. Al Moqbel Palaces, 24°29.496′N, 46°22.106′E, 614 m, 22.xii.2020, VC, (3 w, 3 s); Dirab-Dhurma Rd. Al Moqbel Palaces, 24°29.490′N, 46°22.115′E, 610 m, 22.xii.2020, (4 w); **Al Hair**: Dirab-Al Hair Rd., 5 km to Al Hair, abandoned palm farm, 24°23.690′N, 46°48.073′E, 478 m, 20.xii.2020, (16 w, 5 s); Al Hair, in front of Al-Hair station, 24°23.639′N, 46°49.737′E, 540 m, 20.xii.2020, (3 w); Al Hair-Ryadh Rd., in front of Al-Hair Prison, 24°26.291′N, 46°50.108′E, 527 m, 20.xii.2020, (5 w); Al Hair-Ryadh Rd., in front of Al-Hair Prison, 24°26.289′N, 46°50.123′E, 535 m, 20.xii.2020, (4 w); Al Hair-Ryadh Rd., 24°26.315′N, 46°50.110′E, 525 m, 20.xii.2020, (3 w); Dhurma, 24°36.888′N, 46°05.312′E, 624 m, 22.xii.2020, (9 w); Dhurma, 24°40.900′N, 46°00.396′E, 655 m, 22.XII.2020, (1 w); Dhurma, Dhurma-Ath Tharmida Rd., 15 km out Dhurma, 24°40.896′N, 46°00.367′E, 657 m, 22.xii.2020, (2 w); Dhurma, 24°39.972′N, 46°00.456′E, 654 m, 22.xii.2020, (3 w); Dhurma, 24°26.289′N, 46°50.123′E, 535 m, 22.xii.2020, (4 w); Dhurma, 24°34.363′N, 46°10.924′E, 623 m, 22.xii.2020, (3 w, 4 s); Dhurma-Riyadh Rd., 15 km out of Dhurma, 24°32.678′N, 46°14.555′E, 617 m, 22.xii.2020; (2 w, 5 s); Dhurma-Riyadh Rd., 15 km out of Dhurma, 24°32.678′N, 46°14.555′E, 617 m, 22.xii.2020, (3 w, 1 s); Dhurma, 24°39.978′N, 46°00.458′E, 654 m, 22.xii.2020, (4 w); **Al Dwadmi:** -Al Bijadyah Rd., 24°28.772′N, 44°20.898′E, 999 m, 13.i.2021, (3 w); Al Dwadmi, Near to Al Zamil palace, Al Najashy, 24°28.884′N, 44°21.538′E, 988 m, 13.i.2021, (2 w, 2 s); Al Dwadmi, Mushrifah, (Mohammed Al Haji), 24°28.667′N, 44°21.106′E, 988 m, 13.i.2021, (3 w); Al Dwadmi, Al Dawadmi-Arja Rd, King Khalid Rd., 24°31.613′N, 44°21.294′E, 966 m, 13.i.2021, (3 w, 2 s); Al Dwadmi-Riyadh Rd., 24°34.095′N, 44°29.272′E, 920 m, 13.i.2021, (2 w, 2 s); Al Dwadmi-Riyadh Rd., 24°34.090′N, 44°29.272′E, 912 m, 13.i.2021, (2 w, 2 s); Al Rabwah neighborhood, open area, 24°33.505′N, 44°27.751′E, 928 m, 13.i.2021, (4 w); **Afif**: Dhalam-Afif Rd., 23°50.494′N, 42°53.029′E, 1014 m, 11.i.2021, (3 w, 1 s); Afif-Mahd Al-Dhahab Rd., 23°52.623′N, 42°51.648′E, 1026 m, 12.i.2021, (3 w, 1 s); Al Mehaneyyin neighborhood, near King abdul aziz park, 23°55.567′N,

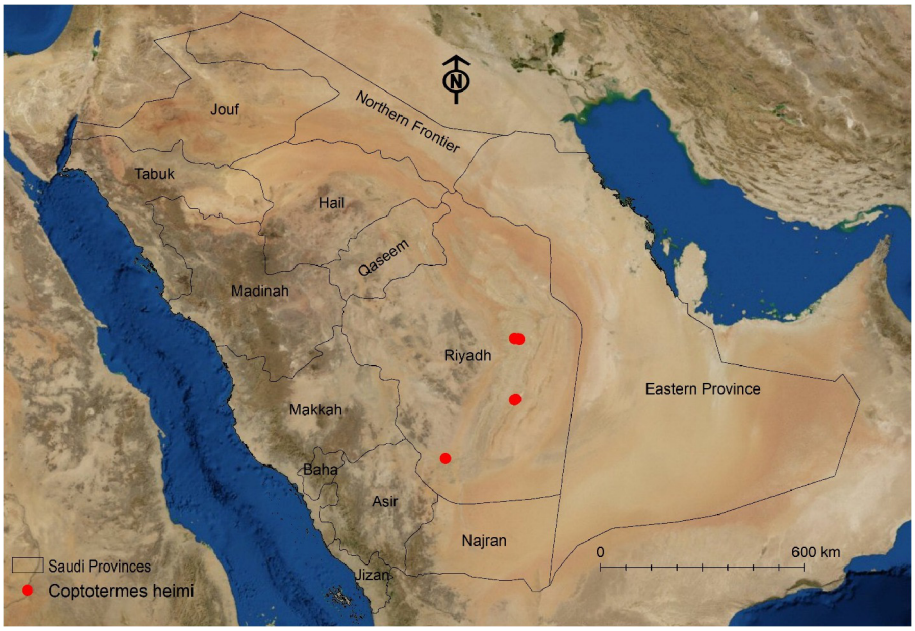

Fig. 4. Distribution map of *Coptotermes heimi*.

42°56.978′E, 1063 m, 12.i.2021, (4 w); Afif-Dhalam Rd., Al Mehaneyyin neighborhood, near King abdul aziz park, 23°55.554′N, 42°56.977′E, 1050 m, 12.i.2021, (4 w); Al-Bajadiah Rd, Al-Moalaq, 24°10.895′N, 43°13.505′E, 1023 m, 12.i.2021, (4 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.418′N, 42°57.488′E, 1052 m, 11.i.2021, (3 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.425′N, 42°57.487′E, 1054 m, 11.I.2021, (3 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.420′N, 42°57.435′E, 1053 m, 11.i.2021, (3 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.409′N, 42°57.438′E, 1056 m, 11.i.2021, (3 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.405′N, 42°57.433′E, 1054 m, 11.I.2021, (3 w); Al Duwadimi-Afif Rd., 6 km to fif, 23°56.407′N, 42°57.437′E, 1057 m, 11.i.2021, (4 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.392′N, 42°57.456′E, 1060 m, 11.I.2021, (2 w); Al Duwadimi-Afif Rd., 6 km to Afif, 23°56.382′N, 42°57.456′E, 1062 m, 11.i.2021, (3 w); Afif-Dhalam Rd., 23°51.908′N, 42°53.584′E, 1022 m, 11.i.2021, (3 w, 1 s); **Al Bijadyah**: Al bajadiah Rd, Al Radyfah, 24°17.700′N, 43°40.608′E, 926 m, 12.i.2021, (2 w, 2 s); Al bajadiah Rd, Al Radyfah, 24°17.704′N, 43°40.620′E, 927 m, 12.i.2021, (4 w); Al Bijadyah, 24°17.912′N, 43°44.195′E, 918 m, 12.i.2021, (4 w); Al Qaseemah, 24°18.227′N, 43°44.254′E, 911 m, 12.i.2021, (6 w); Al Qaseemah, 24°18.235′N, 43°44.271′E, 928 m, 12.i.2021, (3 w); Al Bijadyah-Al Dwadmi Rd., 24°18.853′N, 43°47.342′E, 902 m, 12.i.2021, (4 w); Al Qaseemah, 24°17.912′N, 43°44.195′E, 913 m, 12.i.2021, (3 w); **Sajir:** Sajir-Al Sakran Rd., 25°12.797′N, 44°36.643′E, 718 m, 14.i.2021, (4 w, 1 s); Sajir-Al Sakran Rd., 25°12.646′N, 44°36.105′E, 710 m, 14.i.2021, (4 w); Al Sakran-Sajir Rd., 25°13.394′N, 44°35.963′E, 713 m, 14.i.2021, (3 w); Al Sakran-Sajir Rd., 25°13.391′N, 44°35.957′E, 713 m, 14.i.2021, (3 w, 1 s); Al Sakran-Sajir Rd., 25°13.319′N, 44°35.840′E, 711 m, 14.i.2021, (3 w, 1 s); near King Abdulaziz park, 24°09.879′N, 44°36.009′E, 726 m, 14.i.2021, (2 w, 3 s); Mafraq Albroud, 24°09.080′N, 44°38.747′E, 724 m, 14.i.2021, (3 w, 2 s); Mafraq Albroud, 24°09.077′N, 44°38.767′E, 720 m, 14.i.2021, (3 w, 2 s); Mafraq Albroud, 24°09.076′N, 44°38.788′E, 720 m, 14.i.2021, (4 w); **Shaqraa:** Al Dwadmi-Shaqraa Rd., 25°10.192′N, 45°08.785′E, 749 m, 14.i.2021, (3 w, 1 s); Al Dwadmi-Shaqraa Rd., 25°10.153′N, 45°08.787′E, 751 m, 14.i.2021, (5 w, 1 s); Al Dwadmi-Shaqraa Rd., 25°10.132′N, 45°08.782′E, 759 m, 14.i.2021, (4 w); Shaqraa, 25°15.009′N, 45°14.880′E, 711 m, 15.i.2021, (2 w, 3 s); Shaqraa, valley, 25°15.034′N, 45°14.876′E, 708 m, 15.i.2021, (2 w, 3 s); Shaqraa, 25°15.039′N, 45°14.875′E, 705 m, 15.i.2021, (2 w, 3 s); Shaqraa, 25°15.040′N, 45°14.891′E, 710 m, 15.i.2021, (2 w, 3 s); Shaqraa, 25°15.079′N, 45°14.927′E, 718 m, 15.i.2021, (2 w, 3 s); Shaqraa, 25°15.086′N, 45°14.928′E, 712 m, 15.i.2021, (2 w, 3 s); Ar Rahabah neighborhood, 25°15.628′N, 45°14.206′E, 712 m, 15.i.2021, (2 w, 3 s); Shaqraa, 25°15.101′N, 45°14.932′E, 710 m, 15.i.2021, (2 w, 3 s); Ar Rahabah, 25°15.635′N, 45°14.210′E, 706 m, 15.i.2021, (2 w, 3 s); Ar Rahabah, 25°15.639′N, 45°14.208′E, 704 m, 15.i.2021, (4 w, 2 s); Ar Rahabah, 25°15.645′N, 45°14.206′E, 703 m, 15.i.2021, (4 w, 1 s); Ar Rahabah, 25°15.648′N, 45°14.191′E, 715 m, 15.i.2021, (1 w, 3 s); Shagraa-Ushaiger Rd., 25°15.768′N, 45°14.482′E, 730 m, 15.i.2021, (2 w, 3 s); Shagraa-Ushaiger Rd., 25°15.759′N, 45°14.464′E, 726 m, 15.i.2021, (4 w); Shagraa-Ushaiger Rd., 25°15.666′N, 45°14.710′E, 728 m, 15.i.2021, (2 w, 2 s); Shagraa-Ushaiger Rd., 25°15.430′N, 45°14.560′E, 725 m, 15.I.2021, (2 w, 3 s); Al Qrain, 25°13.255′N, 45°16.800′E, 698 m, 15.I.2021, (3 w, 2 s); **Wadi Ad Dawasir**: Al Asail hotel, 20°25.939′N, 44°53.641′E, 659 m, 4.i.2021, (5 w, 5 s); Al Asail hotel, 20°25.967′N, 44°53.624′E, 650 m, 4.i.2021, (2 w, 4 s); Al Asail hotel, 20°25.984′N, 44°53.613′E, 659 m, 4.i.2021, (2 w, 7 s); Al Asail hotel, 20°25.997′N, 44°53.591′E, 655 m, 4.i.2021, (3 w, 4 s); Al Quwayz, 20°26.590′N, 44°52.259′E, 666 m, 5.i.2021, (2 w, 3 s); Al Quwayz, 20°26.588′N, 44°52.266′E, 663 m, 5.i.2021, (3 w, 2 s); Al Quwayz, 20°26.582′N, 44°52.259′E, 654 m, 5.i.2021, (2 w, 3 s); Al Quwayz, 20°26.571′N, 44°52.262′E, 670 m, 5.i.2021, (2 w, 3 s); Saad Ayedh farm, 20°26.605′N, 44°52.236′E, 664 m, 5.i.2021, (1 w, 5 s); Wadi Ad Dawasir, 20°27.813′N, 44°43.272′E, 686 m, 5.i.2021, (3 w, 3 s);Wadi Ad Dawasir, 20°27.811′N, 44°43.273′E, 678 m, 5.i.2021, (2 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., 20°26.827′N, 44°42.871′E, 685 m, 5.i.2021, (1 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., 20°26.854′N, 44°42.880′E, 693 m, 5.i.2021, (3 w, 2 s); Wadi Ad Dawasir- Khamis Mushait Rd., near Armed Forces Hospital, 20°27.310′N, 44°44.867′E, 669 m, 5.i.2021, (3 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., near Armed Forces Hospital, 20°27.310′N, 44°44.867′E, 677 m, 5.i.2021, (2 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., near Armed Forces Hospital, 20°27.998′N, 44°44.826′E, 676 m, 5.i.2021, (2 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., 20°27.183′N, 44°49.490′E, 669 m, 5.i.2021, (2 w, 3 s); Wadi Ad Dawasir- Khamis Mushait Rd., near King Fahad Park, 20°25.607′N, 44°55.582′E, 644 m, 5.i.2021, (3 w, 3 s); Ad Dawasir- Khamis Mushait Rd., in front of King Fahad Park, 20°25.608′N, 44°55.583′E, 648 m, 5.i.2021, (3 w, 8 s); **As Sulayyil**: 20°26.108′N, 45°31.901′E, 583 m, 6.i.2021, (1 w, 2 s); As Sulayyil, open area, 20°26.104′N, 45°31.901′E, 583 m, 6.i.2021, (2 w, 2 s); Ash Shifa, King Khalid Rd., 20°27.158′N, 45°34.818′E, 596 m, 6.i.2021, (2 w, 2 s); Ash Shifa, King Khalid Rd., 20°27.783′N, 45°34.788′E, 575 m, 6.i.2021, (2 w, 2 s); **Al Aflg:** Al Badie Al Shemali, 22°02.911′N, 46°34.141′E, 539 m, 7.i.2021, (2 w, 1 s); Al Badie Al Shemali, Al Hadar Rd., 22°00.452′N, 46°32.002′E, 533 m, 7.i.2021, (2 w, 2 s); Al Badie As Sulayyil- Al Aflag Rd., 21°59.978′N, 46°32.668′E, 530 m, 7.i.2021, (2 w, 2 s); Al Badie As Sulayyil- Al Aflag Rd., 21°59.719′N, 46°32.674′E, 523 m, 7.i.2021, (2 w, 2 s); El Nebayah-Marwan Rd., 21°05.353′N, 46°37.421′E, 519 m, 7.i.2021, (2 w, 2 s); Swidan, Ayn Um Jabal, 22°09.846′N, 46°42.017′E, 515 m, 7.i.2021, (2 w, 2 s); Swidan, Ayn al Burj, 22°09.850′N, 46°42.014′E, 522 m, 7.i.2021, (2 w, 2 s); **Hawtet bani Tamim**: Al Hareeq Rd., Hawtet bani Tamim Dam, 22°32.037′N, 46°46.747′E, 580 m, 8.i.2021, (2 w, 1 s); Naam-Al Hareeq Rd., 22°35.676′N, 46°43.253′E, 603 m, 8.i.2021, (2 w, 2 s); Naam-Al Hareeq Rd., 22°35.709′N, 46°43.256′E, 603 m, 8.i.2021, (1 w, 2 s); Naam-Al Hareeq Rd., 22°35.649′N, 46°43.447′E, 609 m, 8.i.2021, (1 w, 2 s); Naam-Al Hareeq Rd., Naam park, 23°36.419′N, 46°39.923′E, 626 m, 8.i.2021, (3 w, 2 s); Naam, 23°36.426′N, 46°39.917′E, 617 m, 8.i.2021, (3 w). All specimens are collected by Al Ansi & Sotanto using by handpicking and aspirator (KSMA).

Local distribution (Fig. 5)**.** This species occurs throughout the deserts of the KSA with a remarkable habitat preference of arid sites, whereas it is rarely encountered in the southwestern mountains of the KSA (Chhotani and Bose, 1979; Badawi et al., 1986b).

Geographic range. A Palearctic species that is broadly distributed throughout deserts of the Arabian Peninsula and western coast of Africa to Senegal (Chhotani and Bose, 1979). It is also recorded from several countries in the Afrotropical Region (Eritrea, Ethiopia, Mauritania, Niger; Senegal, South Africa, Sudan) (Krishna et al., 2013).

Foraging/feeding substrate. The nesting habits of this species is remarkably diverse that include dead wood of *Acacia, Calotropis*, *Tamarix*, imported wood, cartoons, wooden buildings, dead date palm fronds on moist soil, plywood, branches of live Cypres trees, and dead date palm trunks.

4. Discussion

There is a specific difference between the armature of the right mandible and the left mandible of *A. ochraceous* and *P. hypostoma*, the former species has the left mandible with 5–7 teeth, and the right mandible with 4–5 teeth, whereas the later species has the left mandible with a terminal tooth and three marginal teeth while the right mandible with a terminal tooth and two marginal teeth.

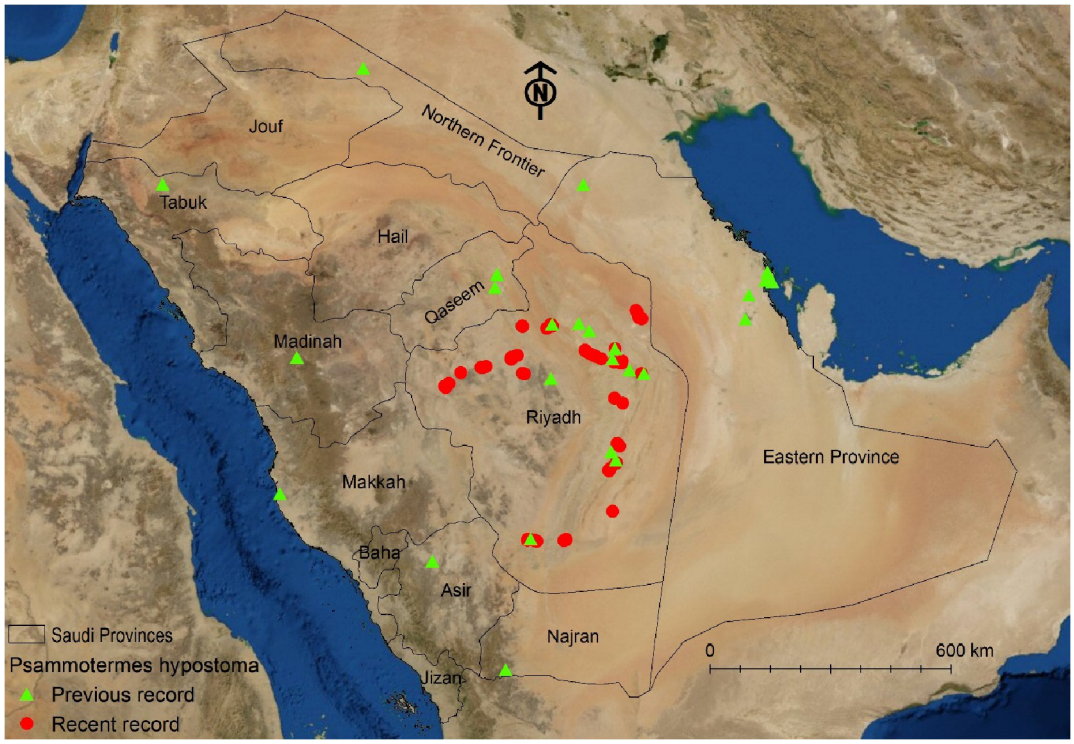

Fig. 5. Distribution map of *Psammotermes hypostoma*.

This morphological mandibular asymmetrical trait is used to dismember ants (Seid et al., 2008).

The geographic location of the Arabian Peninsula at the interchange of three zoogeographical realms, the Palearctic, the Afrotropical and the Oriental, results in a mixing of faunal elements from these regions, especially from the Palearctic and the Afrotropical. In addition, there are limited number of endemic taxa (Larsen, 1984; Cowie 1989; Delany, 1989; Penati and Vienna, 2006; Sharaf et al., 2020). The lack of systematic revisions and taxonomic keys is a challenge toward the identification of Arabian termite species. During the present work only two Palearctic species were collected from the Riyadh Province, *A. ochraceous* and *P. hybostoma* which are fairly abundant in the deserts of the Arabian Peninsula and their geographical range extends south to several locations in the southwestern mountains (Chhotani and Bose, 1979).

According to literature records and our records, it is apparent that *A. ochraceous* and *P. hybostoma* are the two most widely occurring termite species in the KSA but the later species has apparently a wider geographical distribution, no doubt because of available habitats. *Psammotermes hybostoma* prefers the dry habitats therefore it is rarely represented in the southwestern mountains of the KSA due to the higher percentage of precipitation, moist soils, and lower air temperatures (Badawi et al., 1986b).

Coptotermes heimi is a common invasive species native to India, Nepal, and Pakistan (Chouvenc et al., 2016) thriving in deserts habitats of countries of the Arabian Peninsula including the United Arab Emirates (UAE) and Oman. It is anticipated that this species occurring over a wider geographic range, especially in the vast desert regions of the KSA and the rest of the neighboring countries such as Kuwait, Qatar and Bahrain.

5. Conclusions

In the present study an updated synoptic list of the 30 hitherto known Arabian Isoptera is given of which 27 species are recorded from the KSA. During our survey in Riyadh Province three species are sampled, keyed and illustrated, *A. ochraceous* (Burmeister), *P. hypostoma* Desneux, and *C. heimi* (Wasmann). *Anacanthotermes ochraceous*, and *P. hypostoma* are widely distributed on the Arabian Peninsula whereas *C. heimi* appears rare in the region. We give distribution maps for the collected species and present notes on species habitat preference. It is hoped that future collecting will add additional records of termites for the Arabian Peninsula.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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