

VEGETATIONAL DISTRIBUTION OF TERMITES OF RAJASTHAN (INDIA) AND THEIR ECONOMIC IMPORTANCE

by M. L. ROONWAL, F.N.A. Emeritus Scientist (CSIR), Desert Regional
Station, Zoological Survey of India, Jodhpur

and

G. BOSE, Entomology Division, Zoological Survey of India, Calcutta

The termite (Isoptera) fauna of Rajasthan (area 3,42,272 sq. km) has been intensively surveyed during the last few years, and 18 species are known to occur there. The western three-fifths is arid or semiarid and sandy or gravelly and forms a part of the Great Indian Desert which extends also to Sind. The remainder is relatively wet, with deciduous forests which may be dense or open. *Distribution*: Termite distribution is related to vegetation and rainfall zones, and species which are characteristic of each zone are mentioned below in five groups:

Arid zone (open scrub or little vegetation; desert soil, sandy or gravelly): *Anacanthotermes macrocephalus*, *Psammotermes rajasthanicus*, *Eremotermes neoparadoxalis*, *Microcerotermes raja* and *Microtermes mycophagus*.

Semiarid zone (open scrub; under cultivation; soils varying from desert soil to alluvium): *Anitermes belli*, *Eremotermes paradoxalis*, *Microcerotermes raja*, *M. laxmi* and *Trinervitermes biformis*.

Wet zone (open and dense forests; open scrub; under cultivation; red and yellow soils, alluvium and black soil): *Speculitermes cyclops cyclops*, *Synhamitermes quadriceps*, *Eremotermes paradoxalis*, *Odontotermes guptai*, *O. kushwahi*, *Microtermes obesi* and *Trinervitermes biformis*.

Versatile species (occurring in all types of vegetation zones and soils): *Microcerotermes tenuignathus*, *Odontotermes obesus* and *Microtermes obesi*.

Wood-inhabiting species: *Psammotermes rajasthanicus*, *Heterotermes indicola* and *Coptotermes heimi*. The first is restricted to the arid region; and other two are widespread.

Economic importance: Two species, *Heterotermes indicola* and *Coptotermes heimi* (and in the arid region also *Psammotermes rajasthanicus*), damage wood-work. *Anacanthotermes macrocephalus* damages grasses and stored grain. Sugarcane, germinating wheat, maize and millets, are seriously damaged by *Odontotermes obesus* and *Microtermes obesi*; these species also damage seedlings of eucalyptus, mango, guava, as well as garden plants.

I. INTRODUCTION

GENERAL

Rajasthan (area c. 3,42,272 sq. km) is a large State situated on the extreme west of India. The western and north-western portion, separated from the rest by the Aravalli Hills, is arid and forms a part of the Great Indian Desert; the annual rainfall is less than

50 cm, often less, and the vegetation ranges from open, thorny scrub to just a few bushes or none. The southern and south-eastern portion is wet, with higher rainfall and well developed forest areas.

The vegetation may be conveniently divided into either open or dense deciduous forests, open thorny scrub, and areas under cultivation (generally irrigated by wells but by canals in the extreme north). The soil cover varies from desert soils (grey and brown, mostly sand), red and yellow soils, alluvial soils and medium black soils, with their fertility and water-holding capacities more or less in that order.

A good general account of Rajasthan geography will be found in Misra (1967).

2. TERMITE FAUNA

In recent years, the termite fauna of Rajasthan has been intensively studied by Roonwal and Bose (1960-69) and Roonwal (1958-70; and *in press*). Aids for identification together with keys and illustrations, will be found in Roonwal and Bose (1964, 1969) and Roonwal (*in press*).

A total of 18 species, distributed over 3 families and the following 12 genera occur in Rajasthan, the number of species in each genus being given within brackets:

Anacanthotermes (1), *Psammotermes* (1), *Heterotermes* (1), *Coptotermes* (1), *Speculitermes* (1), *Amitermes* (1), *Synhamitermes* (1), *Eremotermes* (2), *Microcerotermes* (3), *Odontotermes* (3), *Microtermes* (2), and *Trinervitermes* (1).

The present account deals with their ecological distribution in relation to vegetation and soil cover.

3. ABBREVIATIONS USED

Besides the conventional abbreviations, the following abbreviations have been used:

Im, imago; *S*, soldier; *W*, worker.

II VEGETATIONAL DISTRIBUTION

Family I: HODOTERMITIDAE

1. *Anacanthotermes macrocephalus* (Desneux)

(Fig. I D)

1906. *Hodotermes macrocephalus* Desneux, *Ann. Soc. ent. Belg.*, Brussels, 49(12), pp. 344-348.
Im. S,W. Type-locality: Karachi (Sind).

This is the largest species found in Rajasthan (length: soldiers with mandibles *c.* 10.5-15.5 mm; workers *c.* 6.5-10.5 mm). It lives in a system of extensive underground galleries which are circular-oval in cross-section and *c.* 5-7 mm in diameter, and makes small conical mounds (*c.* 60-150 mm in height) of heaped, loosely cemented excavated earth. Nesting, as found in Sind, occurs underground; no proper nest has hitherto been described from Rajasthan.

The species occurs from E. Afghanistan, *via* Sind and Punjab, to W. Rajasthan. In Rajasthan its eastern limit is Jodhpur district. It is confined to arid and poorly cultivated areas, open scrub and sandy and gravelly areas of desert soils, with annual rainfall well below 60 cm.

It is a foraging termite and workers may travel considerable distances (several metres) from the exit holes to feed and collect bits of grass stems, seeds and other plant material.

Family II. RHINOTERMITIDAE

2. *Psammotermes rajasthanicus* Roonwal & Bose

(Fig. I D)

1960. *Psammotermes rajasthanicus* Roonwal and Bose, *Sci. & Culture.*, Calcutta, **26** (1), pp. 38-39. S, W. Type-locality: Balana (Jaisalmer District, Rajasthan).

The species is confined to the loose sandy areas (desert soils) of W. Rajasthan (districts of Barmer, Jaisalmer and Bikaner), with little rain (annual average below *c.* 40 cm) and very poor vegetation consisting of a few bushes. It has not yet been recorded outside Rajasthan, though its occurrence in the contiguous arid areas of Sind is not unlikely.

3. *Heterotermes indicola* (Wasmann)

(Fig. I E)

1902. *Leucotermes indicola* Wasmann, *Zool. Jb. (Syst.)* Jena, **17** (1), pp. 118-119. S, W. Type-locality: Bombay (India)

Though recorded in Rajasthan from only a few localities, it has a wide distribution in N. India (down to *c.* 20°N. latitude) and in W. Pakistan. It is a wood-infesting species but maintains connection with the ground where it nests. As it feeds on dry wood, its distribution seems to be relatively less dependent upon natural vegetation and rainfall than that of the soil-dwelling species. In wet areas of Peninsular India below *c.* 20°N. latitude, with evergreen rain forests, it gives place to *H. malabaricus* Snyder.

4. *Coptotermes heimi* (Wasmann)

(Synonym: *Coptotermes parvulus* Holmgren).

(Fig. I E)

1902. *Arrhinotermes heimi* Wasmann, *Zool. Jb. (Syst.)*, Jena, **17** (1), pp. 104, 116. Type-locality: Wallon (Ahmadnagar District, India)

Like *Heterotermes indicola*, this species also infests dry wood and has ground connections. It has been found in all rainfall areas in Rajasthan and in all types of vegetation zones, from dense forests to open sandy areas.

The species is widespread throughout India and W. Pakistan, and does not seem to have any soil preferences.

Family III. TERMITIDAE

5. *Speculitermes cyclops cyclops* Wasmann

(Fig. I F)

1902. *Speculitermes cyclops*, Wasmann, *Zool. Jb. (Syst.)*, Jena, **17** (1), pp. 160-162. Im, W. Type-locality: Khandala near Bombay (India)

This species is not common in Rajasthan. It occurs in relatively moist areas (annual rainfall above *c.* 50 cm) and has so far been obtained from light, open but well stocked forests near Kota (Kolipura) and Jaipur (Ramgarh forest) in desert soils as well as medium black soils. It is entirely soil-dwelling and may construct low earthen mounds. So far only workers have been found in Rajasthan; they are semi-transparent and sluggish.

The genus *Speculitermes* was for long believed to be soldierless, but Roonwal and Chhotani (1960) have found soldiers in an allied species, *S. sinhalensis*, from South India. Soldiers, in any case, are very rare in the genus.

6. *Amitermes belli* (Desneux)

(Fig. 1 F)

1906. *Termes belli* Desneux, *Ann. Soc. ent. Belg.*, Brussels, **49**(12), pp. 352-354.
Im, S, W. Type-locality: Karachi (Sindh).

The species occurs from W. Pakistan to Rajasthan and Delhi. It is relatively moisture-loving and is found in the wet and semiarid zones of Rajasthan (annual rainfall above 30 cm) in open scrub and cultivated areas in the vicinity of water, and in non-sandy soils.

7. *Synhamitermes quadriceps* (Wasmann)

(Fig. 1 F)

1902. *Amitermes quadriceps*, Wasmann, *Zool. Jb. (Syst.)*, Jena, **17** (1), p. 213.
S, W. Type-locality: Khandala near Bombay (India).

The species is uncommon in Rajasthan, and occurs in moist, forested areas in the south-eastern portion with annual rainfall above *c.* 60 cm. It is soil-dwelling and is found in medium black soils. Hitherto only soldiers and workers have been found in Rajasthan.

8. *Eremotermes neoparadoxalis* Ahmad

(Fig. 2 A)

1955. *Eremotermes neoparadoxalis* Ahmad, *Biologia*, Lahore, **1**(2), pp. 252-253,
S. Type-locality: Shahadapur (Sind).

It is a soil-dwelling species and is found in sandy areas, open scrub and cultivated fields in desert soils as well as in red and yellow soils in the arid and semi-arid regions of W. Rajasthan, with annual rainfall below *c.* 60 cm.

9. *Eremotermes paradoxalis* Holmgren

(Fig. 2 A)

1913. *Eremotermes paradoxalis* Holmgren, *J. Bombay nat. Hist. Soc.*, Bombay, **22** (1), pp. 115-116.
S, W. Type-locality: Bangalore (S. India).

This is a small, widespread species (W. Pakistan, and almost the whole of India). It is found in open scrub and cultivated areas in relatively moist zones (wet and semi-arid, with annual rainfall above 30 cm.), and in desert as well as red and yellow soils.

10. *Microcerotermes raja* Roonwal & Bose

(Fig. 2 B)

1964. *Microcerotermes championi raja* Roonwal & Bose, *Zoologica*, Stuttgart, **40** (3), (Heft 113), pp. 26-28. S, W. Type-locality: Balsamand near Jodhpur (Rajasthan).

The species is rare, and is found only in Rajasthan—in desert soils in open scrub and cultivated areas in the semiarid zone with annual rainfall below *c.* 30 cm.

11. *Microcerotermes tenuignathus* Holmgren

(Fig. 2 B)

1913. *Microcerotermes tenuignathus* Holmgren, *J. Bombay nat. Hist. Soc.*, Bombay, **22**(1). pp. 116-117. S, W. Type-locality: Widtal (Gujarat, India).

This is a soil-dwelling species. In Rajasthan it occurs in a variety of zones from arid to wet (both low and high rainfall areas) and in all types of vegetation and soils. Its area also extends to Gujarat, Sind and Baluchistan.

12. *Microcerotermes laxmi* Roonwal & Bose

(Fig. 2 B)

1964. *Microcerotermes tenuignathus laxmi* Roonwal & Bose, *Zoologica*, Stuttgart, **40**(3) (Heft 113), pp. 29-31; 55-56. S, W. Type-locality: Kolayat, Bikaner District (Rajasthan).

This is an uncommon, soil-dwelling species which is found in desert soils in cultivated areas only in the arid zone of W. Rajasthan, with annual rainfall below *c.* 30 cm.

13. *Odontotermes guptai* Roonwal & Bose

(Fig. 2 C)

1962. *Odontotermes bellahunisensis guptai* Roonwal & Bose, *J. Bombay nat. Hist. Soc.*, Bombay, **58**(3), pp. 588-593. S, W. Type-locality: Near Gudha village, Nagaur District (Rajasthan).

This soil-dwelling species occurs in all zones in Rajasthan, from wet to arid, and in open scrub, cultivated and sandy areas, in desert soils as well as in red and yellow soils.

14. *Odontotermes kushwahi* Roonwal & Bose

(Fig. 2 C)

1964. *Odontotermes brunneus kushwahi* Roonwal & Bose, *Zoologica*, Stuttgart, **40**(3) (Heft 113), pp. 33-36; 56. S, W. Type-locality: Bhupalsagar, Udaipur District (Rajasthan).

This species is found in open forests and cultivated areas in red and yellow soils in the wet zone of S. Rajasthan, with annual rainfall above *c.* 60 cm. It is a soil-dwelling species and builds low, earthen mounds *c.* 43 cm. high.

It also occurs in Gujarat and S. India.

15. *Odontotermes obesus* (Rambur)

(Fig. 2 D)

1842. *Termes obesus* Rambur, *Hist. natur. Insectes. Neuropteres*, Paris, p. 304. Im. Type-locality: Bombay (India).

This is one of the most common soil-dwelling species found all over Rajasthan, both in wet and arid areas in all types of vegetation zones (forests, cultivated areas, open

scrub and sandy and gravelly areas). It occurs in all types of soil, from desert soils to alluvium and black soil. The soldiers and workers show a considerable size-range.

In the arid areas (Bikaner, Jaisalmer and Barmer Districts) it is entirely subterranean but in the moister zones encountered as we move east, it builds dome-shaped earthen mounds which are multilocular (i.e. with many chambers) and without buttresses and reach a height of about one metre. Mounds are quite common in the central and southern districts.

The species occurs all over India and W. Pakistan and is also found in Burma. The Rajasthan specimens (soldiers and workers) are morphologically indistinguishable from those occurring elsewhere, but the shape and character of the mounds make us suspect that they may be different.

16. *Microtermes obesi* Holmgren

(Synonyms: *Microtermes anandi* Holmgren and *M. a. curvignathus* Holmgren.)
(Fig. 2 E)

1912. *Microtermes obesi* Holmgren, *J. Bombay nat. Hist. Soc. Bombay*, **21**(3), pp. 787-7888. Im.
Type-locality: Khandala near Bombay (India).

This is a small, soil-dwelling species which is found in all types of vegetation and soils, and in all zones from wet to arid. Swarming occurs in July in day-time after a shower of rain.

The species is widespread in South and Southeast Asia, from W. Pakistan to Thailand.

17. *Microtermes mycophagus* (Desneux)

(Fig. 2 E)

1906. *Termes mycophagus* Desneux, *Ann. Soc. ent. Belg.*, Brussels, **49**, pp. 348-352. Im, S, W. Type-locality: Karachi (Sind).

This is a soil-dwelling species which is found in desert soils as well as in red and yellow soils in open scrub and cultivated areas in the arid and semiarid zones of W. Pakistan, with annual rainfall well below 60 cm. Swarming of alates occurs at night during June to August after heavy rain.

The species also occurs in the neighbouring arid areas of India. (Delhi and E. Punjab) and W. Pakistan.

18. *Trinervitermes biformis* (Wasmann)

(Synonyms: *Trinervitermes heimi* Wasmann: and *T. longinotus* Snyder.)
(Fig. 2 F)

1902. *Eutermes biformis* Wasmann, *Zool. Jb. (Syst.)*, Jena, **17**(1), pp. 133-135. Im, S, W. Type-localities: Khandala near Bombay (India); and Bandarawella (Ceylon).

This is the common foraging nasutiform termite of India, and occurs all over except in the north-west. In Rajasthan it occurs in the wet and semiarid areas and is absent in the very arid western portion. Within these limits it is found in all types of soil and in all types of vegetation, but seems to avoid dense forests.

III-ECONOMIC IMPORTANCE

The earliest 'modern' reference to Rajasthan termites is in the book of a medical man, Adams (1899, p. 387), who, in an interesting 'medico-topographical' account of the 'Western Rajasthan States'; wrote as follows:—

"White ants are so very destructive that they require to be kept down, and arsenic is the remedy. It should be put under the plaster in houses where these troublesome pests come up through the floors and walls; as the drug is poisonous and irritating to the eyes and bronchi if inhaled with dust, which might occur if it be left on the surface. White ants will not attack the wood of Nim tree (*Melia indica**) until it becomes very old and decayed' and wood saturated with salt-water, creosote or tar is also unpalatable to them. Kerosine oil keeps them back for a time, and it is also a good remedy against black ants (*Formica fuliginosa*), which sometimes invades Indian houses in the rains."

All termites are potential pests of woodwork, cloth, paper, books and, in fact, all cellulosic materials, as well as to agriculture, forests and fruit trees and grain in storage; they cause severe damage to woodwork in buildings. The loss so caused is undoubtedly very heavy but precise quantitative figures are not available. Among the crops substantially damaged are sugarcane, cotton, wheat, maize, millets, and chillies. The more destructive and economically important species are mentioned below.

Heterotermes indicola and *Coptotermes heimi* destroy woodwork (beams, doors, windows, furniture) extensively all over, while *Psammotermes rajasthanicus*, which also destroys woodwork, is confined to the very arid areas of W. Rajasthan.

Anacanthotermes macrocephalus, the harvesting termite, cuts grass stems and young transplants, especially *Prosopis* in irrigated plantations; it also damages stored grain such as maize, wheat, etc.

Amitermes belli attacks the roots, bark and branches of *Anogeissus* and *Zizyphus* of both living and dead trees, and is a potential pest of other trees such as shisham (*Dalbergia sisoo*.)

Odontotermes obesus damages lawns and other grasses by cutting roots and also constructing earthen sheets and tubes on the surfaces of grass and on bark of tree beneath which the workers and soldiers move about.

In the southern districts of Udaipur, Chittor and Sawai Madhopur, *Odontotermes obesus* is a major pest of sugarcane; the termite starts eating the ends of setts and ultimately finishes off the entire pith, the hollow being filled by moist soil; the plant, as a consequence, shows stunted growth and ultimately dries up. The attack is more serious in the first four or five months of sowing, and is sometimes so severe that the entire crop has to be destroyed to prevent spread of infestation (Kushwaha, 1961). There and elsewhere it also attacks maize, jowar and germinating wheat as well as seedlings of *Eucalyptus*, several fruit trees such as pomegranate, mango, guava, and other trees, e.g., neem (*Azadirachta indica*), dhok (*Anogeissus* sp.) and the euphorbias.

Microtermes obesi (syn. *M. anandi*) is also a serious pest of sugarcane, bajra, maize, seedlings of wheat as well as garden plants (rose, chrysanthemum, *Amaranthus*).

*Modern name: *Azadirachta indica* A: Juss.

IV. SUMMARY

The termite (Isoptera) fauna of Rajasthan (area 3,43,272 sq. km) has been intensively surveyed during the last few years, and 18 species are known to occur there. The western three-fifths is arid or semiarid and sandy or gravelly, and forms a part of the Great Indian Desert which extends also to Sind. The remainder is relatively wet, with deciduous forests which may be dense or open.

Distribution: Termite distribution is related, at least in part, to vegetation and rainfall zones, and species which are characteristic of each zone are mentioned below in five groups:—

Arid zone (open scrub or little vegetation; desert soil, sandy or gravelly) *Anacanthotermes macrocephalus*, *Psammotermes rajasthanicus*, *Eremotermes neoparadoxalis*, *Microcerotermes raja* and *Microtermes mycophagus*.

Semiarid zone (open scrub; under cultivation; soils varying from desert soils to alluvium): *Amitermes belli*, *Eremotermes paradoxalis*, *Microcerotermes raja*, *M. Laxmi* and *Trinervitermes biformis*.

Wet zone (open and dense forests; open scrub; under cultivation; red and yellow soils, alluvium and black soil): *Speculitermes cyclops*, *cyclops* *Synhamitermes quadriceps*, *Eremotermes paradoxalis*, *Odontotermes guptai*, *O. kushwaha*, *Microtermes obesi* and *Trinervitermes biformis*.

Versatile species (occurring in all types of vegetation zones and soils): *Microcerotermes tenuignathus*, *Odontotermes obesus* and *Microtermes obesi*.

Wood-inhabiting species: *Psammotermes rajasthanicus*, *Heterotermesin dicola* and *Coptotermes heimi*. The first one is restricted to arid region; the other two are widespread.

Economic importance: Two species, *Heterotermes indicola* and *Coptotermes heimi* (and in the arid region *Psammotermes rajasthanicus*) damage woodwork, *Anacanthotermes macrocephalus* damages grasses and stored grain. Sugarcane, germinating wheat, maize and millets are seriously damaged by *Odontotermes obesus* and *Microtermes obesi*; these species also damage seedlings of eucalyptus, mango, guava, as well as garden plants.

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ADDENDUM

Due to the long interval between the presentation of this paper and its final publication much new information has been added. In particular, the following papers should be consulted :—

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