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Feeding group diversity of Termites (Isoptera: Insecta) in Kerala

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Abstract
Termites play an important role as decomposers in ecosystems and also as pests of structural timber and crops. This study, assessed the diversity and abundance of termites across the state of Kerala, based on the worker caste feeding groups. A total of 908 colonies were collected through random sampling representing Kalotermitidae, Rhinotermitidae and Termitidae, inclusive of all four feeding groups. The most dominant was Type II, followed by Type III, Type I and finally Type IV. Among Type II, *Odontotermes* Holmgren and Type III *Dicuspiditermes* Krishna were dominant. Much of Type I were Rhinotermitidae, mostly represented by *Coptotermes* Wasmann and *Heterotermes* Froggatt. In Kalotermitidae, *Cryptotermes* Banks were restricted to coastal areas and human habitations, *Glyptotermes* Froggatt to rainforests and *Neotermes* Holmgren to moist structural timber. The feeding groups differed significantly among habitats, depending on vegetation and habitat disturbances, signalling that termites can act as bioindicators of habitats.

Keywords: Termites, Kerala, feeding group, Kalotermitidae, Rhinotermitidae, Termitidae

1. Introduction
Termites are ecologically important group [13]. They play an important role as decomposers and are also notorious pests of structural timber and crops. The termites which are responsible for damages mainly include drywood, dampwood and subterranean termites. As per Donovan *et al* [7] there exists four types of feeding groups among termites based on the worker gut morphology and their mandibles structure especially the molar plate structure and size of the apical tooth in grinding and pounding groups.
This study, though an ongoing one, in 2 years since 2012, assessed the diversity and abundance of termites across all districts of Kerala based on their feeding group. As of the recent there are 60 species under 28 genera of termites in Kerala [4].

2. Materials and Methods
The results given here are as per our studies conducted in all districts of Kerala. Termite samples from selected areas were collected for a period of 2 years (2012-2014) randomly and they were stored in 80% alcohol. A total of 908 termite colonies under 26 genera were collected.
The generic identification was done using keys in Chhotani [6]. All specimens are deposited in the National Zoological Collections of the Zoological Survey of India (ZSI), at Calicut (Kozhikode), Kerala, India.

3. Results and Discussion
The termites collected belonged to three families- Kalotermitidae, Rhinotermitidae and Termitidae. All the four feeding groups Type I (lower termites- mainly wood and grass feeders), Type II (higher termites-fungus growing wood feeders/litter feeders, micro epiphytes), Type III (organic rich soil feeders/ humus feeders) and Type IV (true soil feeders) were recorded.
The most dominant was Type II feeding group (84%), followed by Type III (12.33%), then Type I (3.5%) and finally Type IV with just one colony which belonged to *Ceylonitermellus* Emerson. (Fig.1).

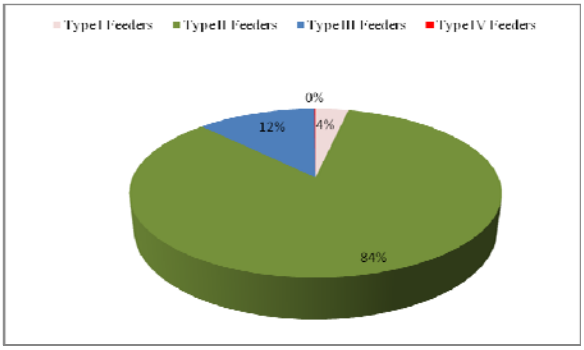

Fig 1: Diversity of feeding group

3.1 Type I feeding group (Fig.2)

In the Type I category which includes the lower termites, belong the drywood and dampwood termites of Kalotermitidae (28%). The drywood forms of *Cryptotermes* Banks the main pests of structural timber are mostly restricted to coastal areas and human habitations. Their occurrence in forest areas is very rare. The dampwood termite *Glyptotermes* Froggatt, the most diverse Kalotermitidae genus is a typical rainforest, while *Neotermes* Holmgren infestation is seen even in structural timber with high moisture content.

Type I also includes Rhinotermitidae (72%), with the pest genera *Coptotermes* Wasmann and *Heterotermes* Froggatt. A highly destructive structural and wooden pest, *Heterotermes indicola* (Wasmann) hitherto not reported from South India was also collected from Kasargode and Malappuram in the recent [2].

As per Bignell *et al* [5] most of the invasive species are either Type I single piece nesters or and intermediate piece nesters or Type II intermediate. The present study could document two invasive species of Type I- *Cryptotermes dudleyi* Banks [1] and *Coptotermes heimi* (Wasmann), form different districts (unpublished).

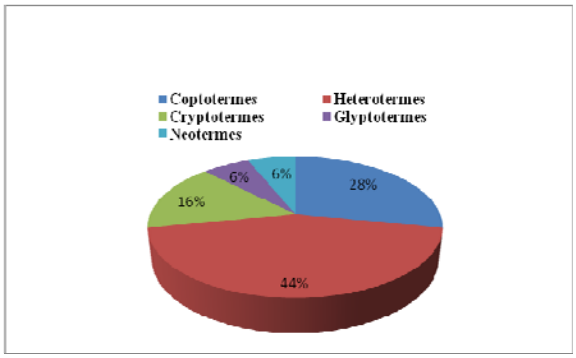

Fig 2: Generic diversity of Type I feeding group

3.2 Type II feeding group (Fig.3)

Among the 764 colonies under 9 genera of Type II, the fungus growing wood/litter feeders were the most dominant with 573 colonies (75%), of which 94% belonged to *Odontotermes* Holmgren, followed by a few colonies of *Microtermes* Wasmann and with colonies of *Hypotermes* Holmgren, even lesser in number (Fig.4). Most of the species of *Odontotermes* are good colonizers, and are often favoured by disturbances and hence with a pest potential. So they are abundant in plantations and near human habitations [8, 12]. The second dominant in Type II (Fig.5) were the wood feeders (21.72%) belonging to *Nasutitermes* Dudley, *Ampoulitermes* Mathur and Thapa and *Microcerotermes* Silvestri followed by 2.5% of microepiphyte feeders under genera *Grallatotermes* Holmgren and *Hospitalitermes* Holmgren and less than 1% grass feeders of *Trinervitermes* Holmgren..

The fungus growing wood litter feeders constitute subfamily Macrotermitinae, whose members are generalist, flexible feeders. Their diet often includes, wood, grass, leaves, herbivore dung, and even hooves and horns of ungulates. Basidiomycetes or the White -rot fungi of *Termitomycetes* spp, with which Macrotermitinae have a digestive mutualism, are efficient aerobic generalist decomposers, which lends the termites great versatility and resource use efficiency [10]. Hence the group enjoys maximum distribution among termites.

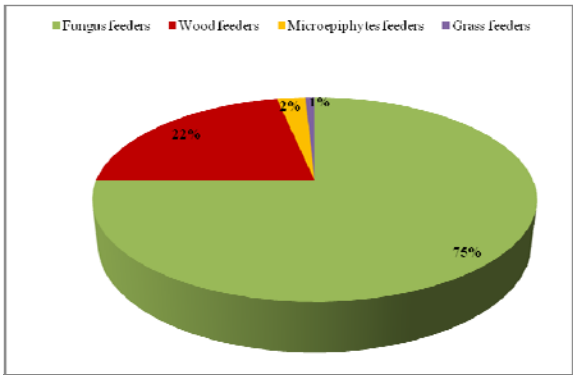

Fig 3: Diversity of Type II feeders

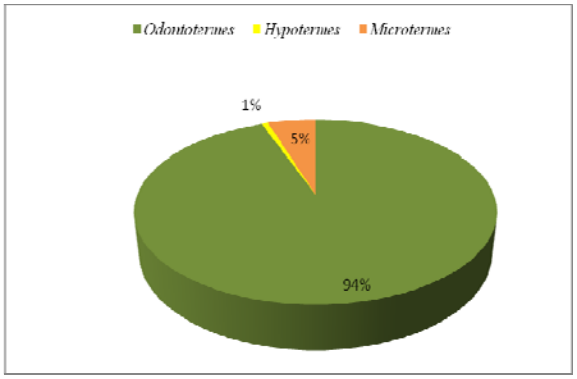

Fig 4: Generic diversity of fungus feeders

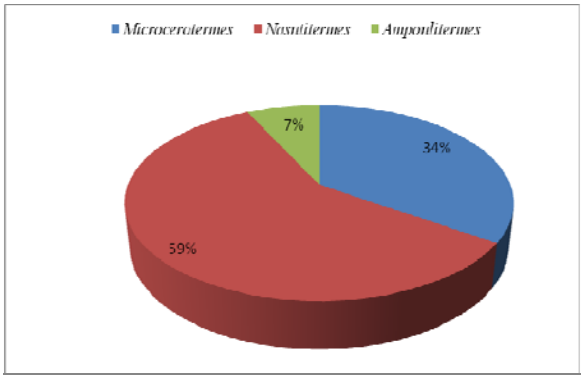

Fig 5: Generic diversity of Type II wood feeders

3.3 Type III feeding group (Fig.6)

Among Type III, the soil dwellers, *Dicuspiditermes* Krishna was the most dominant with 44 colonies (39.29%) followed by *Pericapritermes* Silvestri (14.28%) and then *Pseudocapritermes* Kemner (13.39%). Presence of this feeding group is indicative of soil fertility. Out of 26 genera, 11 genera were belonging to this Type III feeding group.

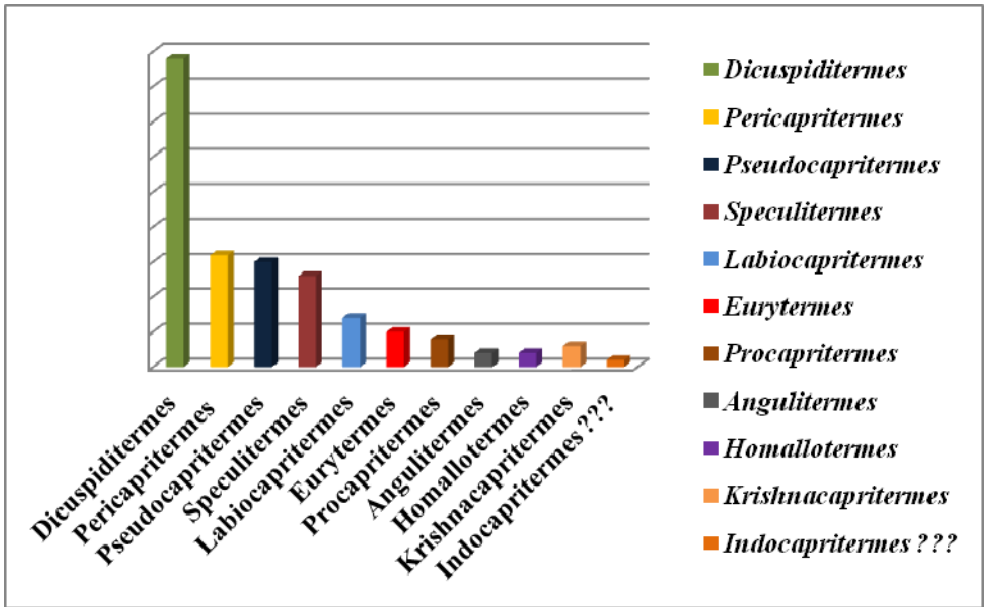

Fig 6: Generic diversity of Type III feeders

According to the Susilo and Aini [11], soil feeding termites are more vulnerable to the microclimate changes than that of wood feeding termites, and this justifies the low diversity of soil or humus feeding termites in the present study too.

3.4 Type IV feeding group

Out of 908 colonies, Type IV feeding group was represented by only one colony which belonged to *Ceylonitermellus* Emerson. Soil feeding is a highly specialised life style in termites and they use the mineralised particles of soil under the humus, which are used by other group of termites [9] and the diversity of soil feeders were decreases with increase in land use intensification [11]. The group was not encountered in any of the collections made from plantation sites or near human habitations, the only record was from an interior forest site in Anchuruli, Periyar Tiger Reserve [3].

4. Conclusion

Our studies indicate that termite assemblage and feeding group structure differed significantly among habitats. Since the diversity and distribution of termites depend on the vegetation type, habitat disturbance and habitat fragmentation, we conclude that termites can be advocated as bioindicators in habitat quality assessments.

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