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Distribution and diversity of Chalcidoidea (Hymenoptera) associated with rice ecosystem in Palakkad district of Kerala state

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Abstract
Chalcidoidea comprises the world`s most important biological control agents. They are parasitoids of many agricultural pests. Some are keystone species and their removal causes cascade effect. Chalcidoidea belong to a Superfamily coming under the order Hymenoptera. It comprises of about 22,000 described species in the world. The study was conducted to find the diversity and distribution of parasitoid wasps of Chalcidoidea (Hymenoptera) in paddy fields of Palakkad district, the granary of Kerala which has large areas under Paddy cultivation. 33 species were collected from the rice ecosystems of the district. About eleven families have been reported from the district. The most dominant genus was found to be *Eurytoma*. The distribution maps and graphs have been provided in this investigation.

Keywords: Chalcidoidea, Parasitoid wasps, Palakkad district

1. Introduction
The study is on the distribution and diversity of Superfamily Chalcidoidea associated with rice ecosystem in Palakkad. The members of Chalcidoidea are mostly primary parasitoids of other insects which include pests of agricultural crops (some are phytophagus and some others are hyperparasitoids). They play a vital role in the ecosystem by keeping the excessive increase of many insect pests under economic injury level. Many Chalcidoids are potential parasitoids which can be of use in undertaking biological control work against noxious insect pests including of paddy pests. Palakkad has large area under paddy cultivations and it is known as the Rice bowl of Kerala. Hence it was proposed to undertake a study on the distribution and diversity of Chalcidoidea occurring in the rice ecosystems of this district.

The parasitic Hymenoptera includes the most successful biological control agents which come under Superfamily Chalcidoidea and Order Hymenoptera. The Superfamily Chalcidoidea contains 20 families, 22,000 known genera and an estimated diversity of 60,000 to more than 5 lakh species, meaning a vast majority have yet to be discovered and described. Most of the species are parasitoid; attacking egg or larval stage of the host. It has a significant part to play in ecosystem. (Grissel and Schauff, 1990) [9] It has been inferred that the study of Chalcidoidea may have begun well before 200 years ago when Linnaeus discovered and reported a few species. After Linnaeus (1767), it was Fabricius (1787) [6] who first coined the name Chalcid from which the present scientific name Chalcidoidea was derived. Since then Latreille (1817) [10], Ashmead (1897, 1904a) [1, 2], Walker (1834) contributed to the study of Chalcidoidea. Since then our knowledge on the Superfamily has been further enhanced by the studies of a number of workers, like Cameron, Crawford, Girault, Masi etc. Some of the notable contributions to the knowledge of this Superfamily, in the recent years are the studies of Bouček, Steffan, Grissel, Noyes and others. In the Indian context Mani and his students, Hayat and his students and Narendran and his students contributed to the study of Chalcidoidea. Other than a paper on Chalcidoids associated with rice ecosystem in Palakkad district by Beevi *et al.* (2000) [3], no concentrated effort has been made exclusively on the Chalcid fauna of rice ecosystems of Kerala, the present work was proposed.

2. Methods
Specimens were collected from different paddy fields of Palakkad district of Kerala. The collection of specimens was directly from the rice field. Capturing and preserving specimens is essential for systematic studies. Standard entomological collection equipments include Sweep net, Malaise trap, Moericke trap, Pitfall trap etc. The collection was done by Sweeping method, but several other methods such as rearing from host insects etc are done. Sorting and mounting were done using Olympus (Japan made) microscope. Card mounted specimens were studied and illustrated using the drawing tube of M3Z Wild Stereo zoom (Switzerland) and Leica Mz6 Stereozoom (Switzerland) microscope. Depending on the size of specimens, some figures were enlarged using KB enlarged of model B2M.

3. Observation
Chalcidoidea are one of the largest groups coming under parasitic Hymenoptera. There is little dispute that the Hymenoptera parasitoids are extremely important group of biological control agents. Greathead (1986) [8] showed that out of 393 species of parasitoids, which have been established in classical biological control programmes, 344 (87%) have been parasitic Hymenoptera.

The analysis was done on the paddy fields at different crop ages in the district. The collection methods followed were mainly using the sweep net. The collection was done by

sweeping the paddy fields mostly before emergence of panicle. Sweeps made in rice field after harvest showed relatively less occurrence of natural enemies, possibly as the parasitoids might have migrated to nearby shrubs or herbs. The specimens could be collected easily during harvest due to disturbance of their habitat. The collections were found dwindling during the rainy season and in insecticide sprayed areas. During emergence of panicle, the use of pesticides affected the chalcid population seriously. When little or no insecticide is used, tropical irrigated rice fields possess a rich arthropod community including many different kinds of natural enemies (FAO, 1979; Greathead, 1979) [5, 7].

Application of high doses of pesticides severely reduces the population level of both host population and parasitoids, with resultant local extirpation of parasitoid resurgence in host population. Parasitoids also show higher sensitivity to other types of environmental perturbations. Pest outbreaks in areas under biological control are found next to dirt roads, where traffic produces dust. The presence of dust interferes with action of parasitoids and kills parasitoids as effectively as many pesticides (Rosen and DeBach, 1990).

The Superfamily contains 23 families viz., Trichogrammatidae, Rotoitidae, Mymaridae, Tanaostigmatidae, Encyrtidae, Eupelmidae, Eulophidae, Aphelinidae, Leucospidae, Chalcididae, Agaonidae, Torymidae, Pteromalidae, Signiphoridae, Tetracampidae, Eurytomidae, Eucharitidae, Perilampidae, Ormyridae, Eriaporidae, Azotidae, Khutelchalcidae (extinct) and Cynipencyrtidae. Among these the last three mentioned are not found in India. Of this, six families (Rotoitidae, Leucospidae, Agaonidae, Signiphoridae, Tetracampidae, Mymarommatidae) are not associated with the rice ecosystem. Chalcidoids were collected from the paddy fields of Palakkad district as a part of the study. In this investigation, eleven families have been dealt with: Family Eulophidae accounts for 18% (*Chrysonotymia sp.* Ashmead, *Elasmus kollimalaianus* Mani & Saraswat, *Pediobius inexpectatus* Kerrich, *Neomestocharella keralensis* Narendran and Fousi, *Stenomesius japonicus* (Ashmead), *Tetrastichus tunicus* Narendran, *T. schoenobii* Ferriere. *T. krishnieri* Mani, *T. krishnaiahi* Saraswat) Chalcididae 6% (*Antrocephalus dividens* Walker, *Antrocephalus mitys* Walker, *Brachymeria minuta* (Linn.), *Epitranus erythrogaster* Cameron, *Hockeria atra* Masi, *Tropimeris monodon* Boucek), Eurytomidae 53% (*Eurytoma sheelae* Narendran, *Eurytoma manilensis* Narendran, *Eurytoma braconidis* Ferriere, *E.amaranthusa* Narendran, *Eurytoma rajeevi, Eurytoma poroensis* Mukerjee, *Philolema maleena* Narendran, *Plutarchia keralensis* Narendran & Padmasenan, *Neobephrata petiolata* Narendran and *Tetramesa nupera* sp.nov.), Pteromalidae 15% (Genus *Callitula* Spinola and genus *Homoporus* (were identified up to the generic level), *Trichomalopsis ovigastra* Sureshan and Narendran and *T. apanteloctena* (Crawford). *Propicroscytus mirificus* (Girault). *Systasis dasyneurae* (Mani), *Panstenon collaris* Bouček), Eupelmidae 2% (*Eupelmus yakkarensis sp.nov.* and *Neanastatus cinctiventris* Girault), Torymidae has *Torymoides kiesenwetteri* Mayr. The pie chart, graphs, distribution maps have been provided below.

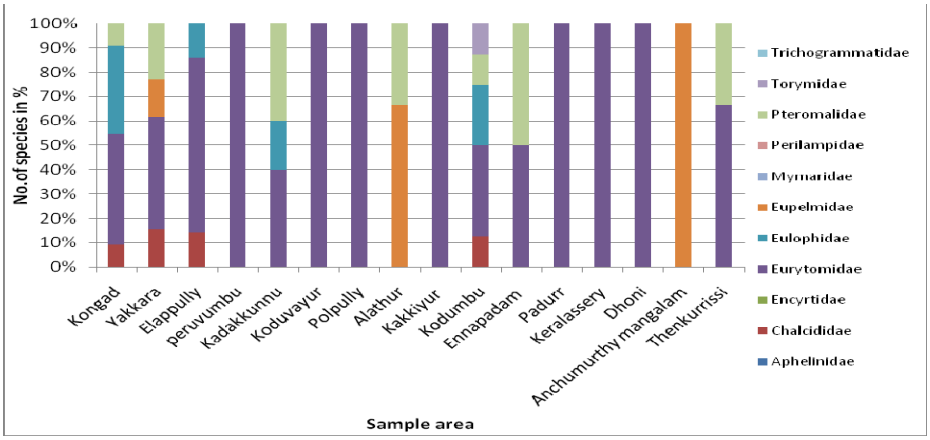


Fig 1: Representation of species belonging to 11 families of super family Chalcidoidea associated with rice ecosystem

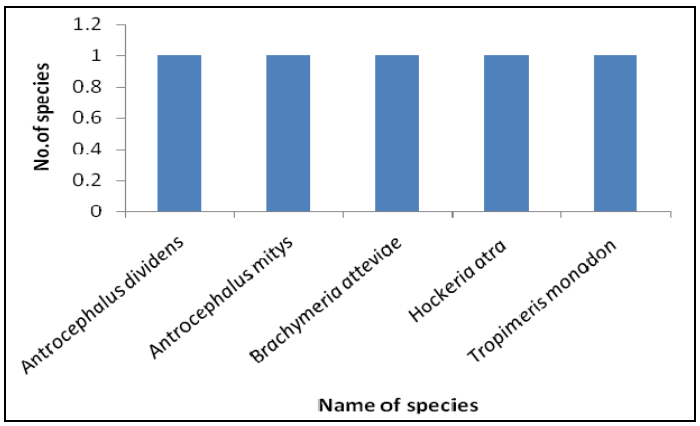


Fig 2: Representation of species in family Chalcidoidea associated with rice ecosystem

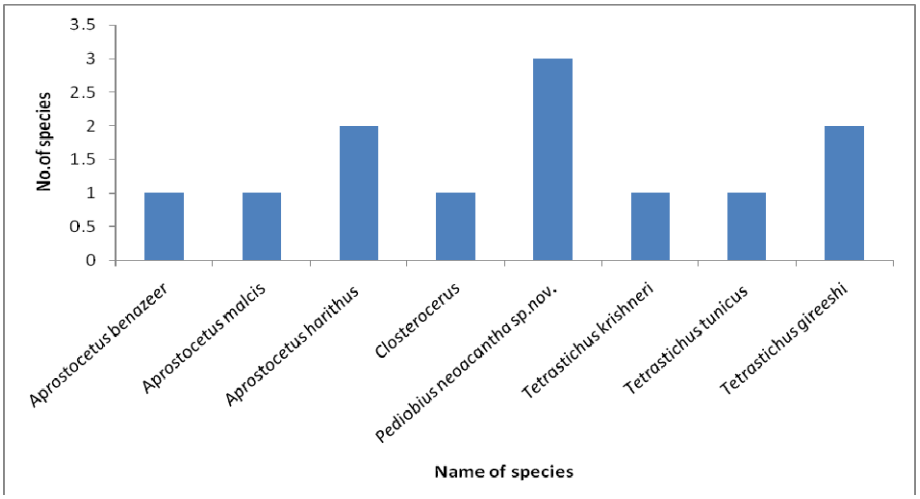


Fig 3: Representation of species in family Eulophidae associated with rice ecosystem

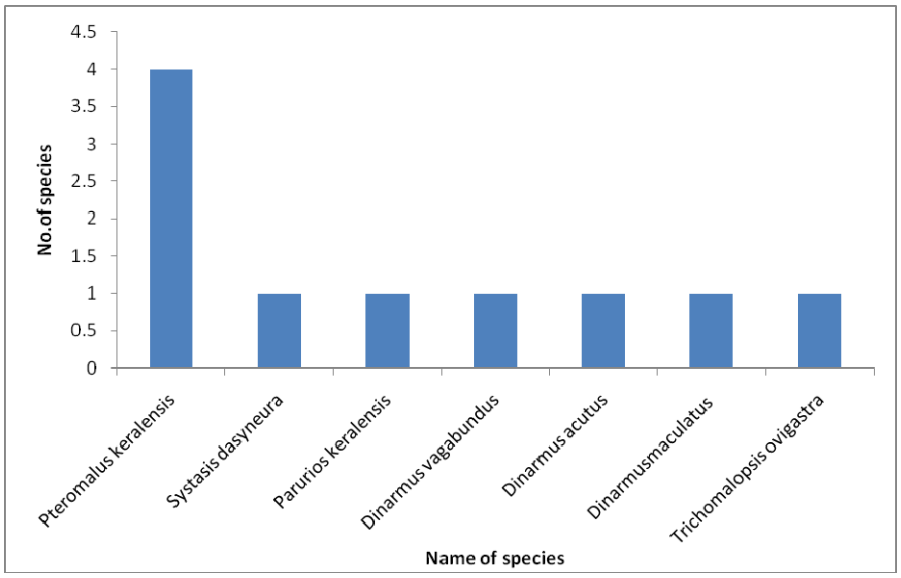


Fig 4: Representation of species in family Pteromalidae associated with rice ecosystem

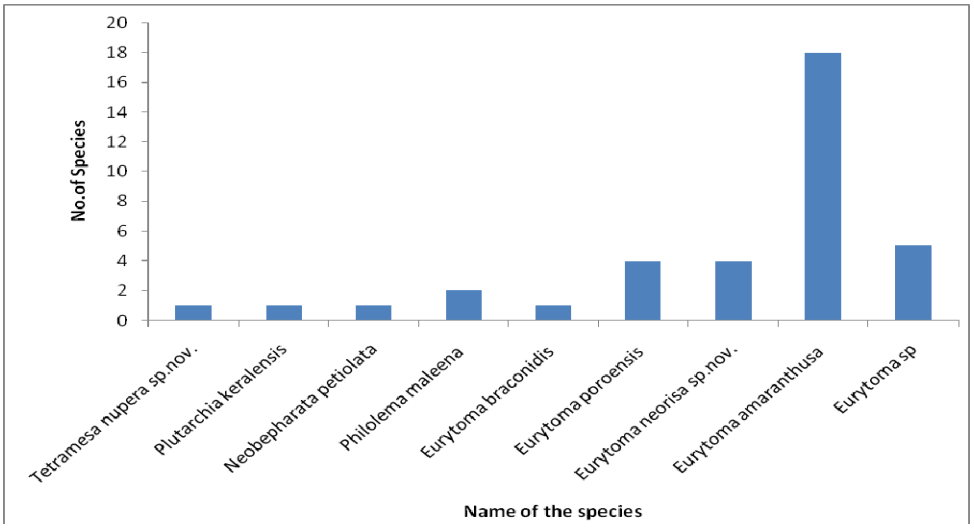
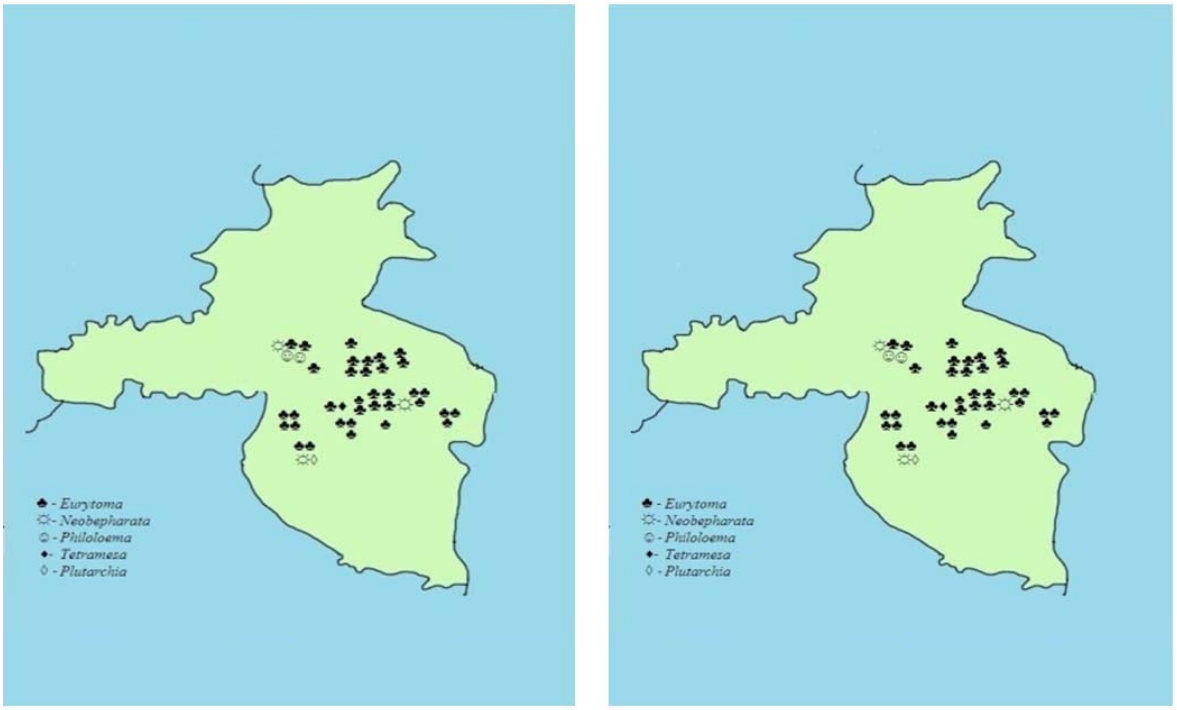


Fig 5: Representation of species in family Eurytomidae associated with rice ecosystem



Family Eurytomidae **Family Eulophidae**

Fig 6: Distribution of genera of associated with rice ecosystem in Palakkad district

4. Summary

A total of 33 species were collected from the various paddy fields of Palakkad. The family Eurytomidae dominated the eleven families under the Superfamily Chalcidoidea, the genus *Eurytoma,* Eulophidae follows with the genus *Tetrastichus* dominated others in this family. Family Pteromalidae follows with the genus *Dinarmus* and of Chalcididae. Of this family, the genus *Brachymeria* found to be most speciose.

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