



Research Article

DIVERSITY AND COMMUNITY STRUCTURE OF ARTHROPODS ON RICE PANICLE

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Abstract- A study was conducted in Balangir and Bargarh districts of Odisha during wet season on the popular rice varieties Swarna and Lalat during 2014 and 2015 to evaluate the diversity of different fauna visiting the panicle from flowering to maturing. Organisms were collected using sweep net method and visual observation. Overall, 126 species were observed that belonged to 110 genera, 40 families of insects, 8 families of spiders and 3 families of birds under 11 orders. Lepidopterans constituted the highest number species (21%) followed by the hymenopterans (18%), hemipterans (17%). Spiders represented only 10% of the species. Hemipterans were collected in highest number (223).

Key words- rice, panicle, fauna, diversity, guild.

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Introduction

Rice fields are considered temporary wetlands characterized by rapid physical, chemical and biological changes that contain greater biodiversity, especially arthropods, compared with other agricultural crops. Ecologically complex communities provide a broader spectrum of niches and sustain larger and more diverse population of predators and parasitoids. In agro-ecosystems, the associated biota can perform important ecological services, like pollination and biological control [1]. As regards environmental factors the diversity and community structure of arthropods and other fauna in rice ecosystem has been studied by several workers [2-5]. These studies have stressed mainly on the harmful and beneficial fauna prevalent in the rice field and rice habitat. Kobayashi and Nugaliyadde [6] made a study on the damage of rice panicles caused by insect pests and examined the arthropod fauna associated with rice panicles at the flowering stage mainly on the basis of species groups. However, information on the occurrence of various fauna on specific parts of the rice plant irrespective of its functional role is very limited. Natural enemies and aquatic insects in rice fields all over the world are well documented. However, there are limited literatures on terrestrial insect diversity in rice field particularly during flowering stage. Insects are particularly important in contributing to the damage of rice plant. During flowering stage, farmers generally do not practice pesticide application to avoid damaging the flowers and eventually the grain formation ([7]. A remarkably high diversity of insects have been reported to visit rice flowers in China and carry large amounts of rice pollen and increase the frequency of transgene flow [8]. Interaction networks between plants and their floral visitors are currently among the most widely studied interactions [9]. The panicle is an important part of the rice plant as it bears the paddy grains. Therefore, an attempt has been made to evaluate the diversity of different fauna visiting the panicle from flowering to maturing.

Materials and Methods

Insects were collected in Balangir and Bargarh districts of Odisha during wet season (Kharif season) on the popular rice varieties Swarna and Lalat during 2014 and 2015. Observation and collections were undertaken between 8 a.m. and 3 p.m. at two hours interval during flowering of the crop. Large insects were collected using a sweep net. Small insects were collected by covering the panicle with transparent plastic bags. Samples of larval stages were taken by hand picking. Four samples were taken from each field with a 38-cm-diameter sweep net. Each sample consisted of 10 consecutive 180 arc sweeps with a sweep made on each forward step while walking through the rice field [10]. Four locations in each rice field were randomly selected along two diagonals each at a distance of 0.5 m interior from the rice field margin. Contents of the sweeps from each sample unit were bagged in zipped polyethylene and frozen for later analysis in the laboratory. After counting and recording, the insects were placed individually into tubes containing solution of 3:1 ethanol absolute: acetic acid to allow follow up identification. The insects and spiders collected from the fields were identified and classified into the smallest possible taxa using available keys and guides for the different taxa. Barrion & Litsinger [11] was referred to for identification of rice pests and their natural enemies. The spiders were identified by using the key provided by Barrion & Litsinger [11] and Tikader [13]. The birds were identified using the book by Ali [14]. These guilds were based on feeding habits and included phytophages (rice pests and non-rice pest visitors), predators and parasitoids. The provisionally identified specimens of arthropods were confirmed by comparing with reference specimens available at ICAR-NRRI, Cuttack, Odisha. The identity of certain specimens was further confirmed by local and overseas taxonomists. Biological status of the animal fauna was established by actual observation, by rearing them in the laboratory or referring to its functional status as in published literature. The comprehensive check lists prepared is intended to serve a database on the faunal diversity of panicle visiting organisms.

Results

The study resulted in collection of 860 specimens and identification of 126 species that belonged to 110 genera, 40 families of insects, 8 families of spider and 3 families of birds under 11 orders [Table-1]. Lepidopterans constituted the highest number species (21%) followed by the hymenopterans (18%), hemipterans (17%). Spiders represented only 10% of the species visiting rice panicle [Fig-1]. Spiders being general predators could be attracted by the insects harbouring the panicle. Hashim et al., [7] studied the diversity and guild structure of insects during rice flowering stage in Malaysia and found Hemiptera as the most dominant insect in the rice field. Nasiruddin and Roy [15] also observed high number of hemipteran pests during flowering stage of rice plant. In the present study of faunal diversity on panicles only, hemipterans were the third dominant group.

However, maximum number of specimens (223) collected during the study was hemipterans. As many of the hemipteran species such as *Leptocorisa*, *Hysteroneura*, *Cofana*, *Nephotettix*, *Menida*, *Nezra* etc. feed on rice grain their number increased the panicle harboured more specimens compared to others. The collected insect specimens were classified into different major guilds namely pests (rice and non-rice), predators (of rice pests and non-rice pests), parasitoid (of rice pests and non-rice pests), hyper parasitoid, neutral species and species with unknown role. The highest percentage of organisms captured belonged to rice pests (32%) and predators (32%) followed by parasitoid of rice pests (17%). Non-rice pests such as that of mango, gourd, *Azolla* sp., pulses etc. accounted for 6% of the total species recorded on rice panicle [Fig-2].

Table-1 List of organisms on rice panicle and guild structure classification

Genus/Species	Order	Family	No. of specimens	Guild structure
<i>Aphanognmus fijiensis</i> (Ferr.)	Hymenoptera	Ceraphronidae	8	Hyper-parasitoid
<i>Trichomalopsis apanteloctena</i> (Craw.)	Hymenoptera	Pteromalidae	4	Hyper-parasitoid
<i>Apis dorsata</i> Fabr.	Hymenoptera	Apidae	14	Neutral
<i>Helicomitus</i> sp.	Neuroptera	Ascalaphidae	1	Neutral
<i>Blepharella lateralis</i> Macquart	Diptera	Tachinidae	4	Parasitoid (Castor pest)
<i>Carcelia</i> sp.	Diptera	Tachinidae	4	Parasitoid (Rice pest)
<i>Halydaia luteicornis</i> Walker	Diptera	Tachinidae	3	Parasitoid (Rice pest)
<i>Peribaea orbata</i> Weidemann	Diptera	Tachinidae	4	Parasitoid (Rice pest)
<i>Thecocarcelia occulata</i> Baranov	Diptera	Tachinidae	12	Parasitoid (Rice pest)
<i>Bracon chinensis</i> (Szepilgeti)	Hymenoptera	Braconidae	4	Parasitoid (Rice pest)
<i>Cardiochiles nigricollis</i> Cam.	Hymenoptera	Braconidae	4	Parasitoid (Rice pest)
<i>Chaenusa</i> sp.	Hymenoptera	Braconidae	2	Parasitoid (Rice pest)
<i>Hormius</i> sp.	Hymenoptera	Braconidae	8	Parasitoid (Rice pest)
<i>Rhaconotus</i> sp.	Hymenoptera	Braconidae	2	Parasitoid (Rice pest)
<i>Antrocephalus dividens</i> Walker	Hymenoptera	Chalcidae	2	Parasitoid (Rice pest)
<i>Brachymeria albotibialis</i> Ashmead	Hymenoptera	Chalcidae	2	Parasitoid (Rice pest)
<i>Tetrastichus schoenobii</i> Ferriere	Hymenoptera	Eulophidae	4	Parasitoid (Rice pest)
<i>Camponotus sericeous</i> (Fabr.)	Hymenoptera	Formicidae	2	Parasitoid (Rice pest)
<i>Iridomyrmex</i> sp.	Hymenoptera	Formicidae	6	Parasitoid (Rice pest)
<i>Gambroides javensis</i> (Rohwer)	Hymenoptera	Ichneumonidae	2	Parasitoid (Rice pest)
<i>Ichneumon</i> sp.	Hymenoptera	Ichneumonidae	8	Parasitoid (Rice pest)
<i>Ischnojoppa luteator</i> Fabr.	Hymenoptera	Ichneumonidae	10	Parasitoid (Rice pest)
<i>Temelucha philippinensis</i> (Ashm.)	Hymenoptera	Ichneumonidae	7	Parasitoid (Rice pest)
<i>Xanthopimpla flavoliniata</i> Cam.	Hymenoptera	Ichneumonidae	14	Parasitoid (Rice pest)
<i>Homonotus</i> sp.	Hymenoptera	Pompilidae	3	Parasitoid (Rice pest)
<i>Gryon</i> sp.	Hymenoptera	Scelionidae	6	Parasitoid (Rice pest)
<i>Telenomus dignoides</i> Nixon	Hymenoptera	Scelionidae	6	Parasitoid (Rice pest)
<i>Trichogramma</i> sp.	Hymenoptera	Trichogrammatidae	2	Parasitoid (Rice pest)
<i>Argyrophylax nigrotibialis</i> Baranov	Diptera	Tachinidae	2	Parasitoid (Rice pest)
<i>Nymphula responsalis</i> Walker	Lepidoptera	Pyalidae	2	Pest (Azolla)
<i>Aulacophora foveicollis</i> (Lucas)	Coleoptera	Chrysomelidae	1	Pest (Gourd)
<i>Saustus gremius</i> Fab.	Lepidoptera	Hesperiidae	2	Pest (grass)
<i>Spodoptera cillum</i> Guenee	Lepidoptera	Noctuidae	2	Pest (grass)
<i>Amritodus atkinsoni</i> (Leth.)	Hemiptera	Cicadellidae	2	Pest (Mango)
<i>Hecalus porrectus</i> Walk	Hemiptera	Cicadellidae	2	Pest (Pulses)
<i>Paraponyx fluctuosalis</i> Zeller	Lepidoptera	Pyalidae	4	Pest (Weed)
<i>Hydrellia philippina</i> Ferino	Diptera	Ephydriidae	6	Pest of rice
<i>Leptocorisa oratorius</i> (Fabr.)	Hemiptera	Alydidae	22	Pest of rice
<i>Leptocorisa acuta</i> (Thunberg)	Hemiptera	Alydidae	12	Pest of rice
<i>Hysteroneura setariae</i> Thomas	Hemiptera	Aphididae	24	Pest of rice
<i>Cofana spectra</i> Distant	Hemiptera	Cicadellidae	18	Pest of rice
<i>Cofana unimaculata</i> Sign.	Hemiptera	Cicadellidae	2	Pest of rice
<i>Nephotettix nigropictus</i> (Stal)	Hemiptera	Cicadellidae	42	Pest of rice
<i>Nephotettix virescens</i> (Distant)	Hemiptera	Cicadellidae	24	Pest of rice
<i>Nilaparvata lugens</i> (Stal)	Hemiptera	Delphacidae	24	Pest of rice
<i>Sogatella furcifera</i> (Horvath)	Hemiptera	Delphacidae	12	Pest of rice
<i>Balcluthina viridis</i> Pruthi	Hemiptera	Jassidae	4	Pest of rice
<i>Menida histrio</i> Fab	Hemiptera	Pentatomidae	8	Pest of rice
<i>Nezra viridula</i> Fab.	Hemiptera	Pentatomidae	12	Pest of rice
<i>Brachmia arotraea</i> (Meyrick)	Lepidoptera	Gelechiidae	4	Pest of rice
<i>Ampittia dioscorides</i> (Fabr.)	Lepidoptera	Hesperiidae	4	Pest of rice
<i>Borbo</i> sp.	Lepidoptera	Hesperiidae	2	Pest of rice
<i>Parnara naso</i> (Fabricius)	Lepidoptera	Hesperiidae	3	Pest of rice
<i>Pelopidas mathia</i> (Fabricius)	Lepidoptera	Hesperiidae	4	Pest of rice
<i>Telicota colon</i> Fab.	Lepidoptera	Hesperiidae	3	Pest of rice
<i>Euproctis xanthorrhoea</i> (Kollar)	Lepidoptera	Lymantiridae	6	Pest of rice
<i>Laelia fasciata</i> (Moore)	Lepidoptera	Lymantiridae	7	Pest of rice

<i>Psalis pennatula</i> (Fabricius)	Lepidoptera	Lymantriidae	4	Pest of rice
<i>Leucania loreyi</i> Duponchell	Lepidoptera	Noctuidae	5	Pest of rice
<i>Leucania venalba</i> Moore	Lepidoptera	Noctuidae	12	Pest of rice
<i>Naranga diffusa</i> Walker	Lepidoptera	Noctuidae	4	Pest of rice
<i>Pseudolelia separata</i> Walk	Lepidoptera	Noctuidae	4	Pest of rice
<i>Sesamia inference</i> (Walker)	Lepidoptera	Noctuidae	4	Pest of rice
<i>Chilo auricilius</i> Dudgeon	Lepidoptera	Pyralidae	4	Pest of rice
<i>Chilo suppressalis</i> (Walker)	Lepidoptera	Pyralidae	5	Pest of rice
<i>Cnaphalocrocis medinalis</i> (Guenee)	Lepidoptera	Pyralidae	12	Pest of rice
<i>Marasmia exigua</i> (Butler)	Lepidoptera	Pyralidae	12	Pest of rice
<i>Nymphula depunctalis</i> (Guenee)	Lepidoptera	Pyralidae	10	Pest of rice
<i>Scirpophaga incertulas</i> (Walker)	Lepidoptera	Pyralidae	18	Pest of rice
<i>Scirpophaga innotata</i> (Walker)	Lepidoptera	Pyralidae	4	Pest of rice
<i>Scirpophaga nivella</i> (Fabricius)	Lepidoptera	Pyralidae	2	Pest of rice
<i>Atractomorpha crenulata</i> Fab.	Orthoptera	Acrididae	5	Pest of rice
<i>Oxya velox</i> (Fabr.)	Orthoptera	Acrididae	14	Pest of rice
<i>Euscyrtyus concinnus</i> de Haan	Orthoptera	Gryllidae	4	Pest of rice
<i>Stenchaetothrips biformis</i> (Bagn.)	Thysanoptera	Thripidae	11	Pest of rice
<i>Lonchura malaca</i> (Linn.)	Aves	Estrildidae	65	Pest of rice
<i>Ploceus philippinus</i> (Lin.)	Aves	Ploceidae	52	Pest of rice
<i>Psittacula krameri</i> Scopoli	Aves	Psittacidae	34	Pest of rice
<i>Oenopia billieti</i> (Mulsant)	Coleoptera	Coccinellidae	2	Predator (Aphids)
<i>Illeis indica</i> Timb.	Coleoptera	Coccinellidae	1	Predator (Mulberry pest)
<i>Araneus variegatus</i>	Araneae	Argiopidae	9	Predator (Rice pest)
<i>Argiope catenulate</i> Doleschall	Araneae	Argiopidae	14	Predator (Rice pest)
<i>Pardosa annandali</i> Gravely	Araneae	Lycosidae	2	Predator (Rice pest)
<i>Pardosa</i> sp.	Araneae	Lycosidae	8	Predator (Rice pest)
<i>Oxyopes pandae</i> Tikader	Araneae	Oxyopidae	6	Predator (Rice pest)
<i>Oxyopes sunandae</i> Tikader	Araneae	Oxyopidae	1	Predator (Rice pest)
<i>Marpissa mandali</i> Tikader	Araneae	Salticidae	3	Predator (Rice pest)
<i>Plexippus paykulli</i> (Audouin)	Araneae	Salticidae	1	Predator (Rice pest)
<i>Tetragnatha maxillosa</i> Thorell	Araneae	Tetragnathidae	12	Predator (Rice pest)
<i>Tetragnatha virescens</i> Okuma	Araneae	Tetragnathidae	3	Predator (Rice pest)
<i>Tetragnatha javana</i> (Thorell)	Araneae	Tetragnathidae	13	Predator (Rice pest)
<i>Thomisus cheraunjeus</i> Tikader	Araneae	Thomisidae	2	Predator (Rice pest)
<i>Colliuris fuscipennis</i> Chaudoir	Coleoptera	Carabidae	12	Predator (Rice pest)
<i>Coccinella arcuata</i> (Fabr.)	Coleoptera	Coccinellidae	12	Predator (Rice pest)
<i>Coccinella repanda</i> (Thunberg)	Coleoptera	Coccinellidae	24	Predator (Rice pest)
<i>Coccinella transversalis</i> Fabr.	Coleoptera	Coccinellidae	8	Predator (Rice pest)
<i>Epilachna sparsa</i> Hbst.	Coleoptera	Coccinellidae	4	Predator (Rice pest)
<i>Menochilus sexmaculatus</i> (Fabr.)	Coleoptera	Coccinellidae	18	Predator (Rice pest)
<i>Micraspis discolor</i> (Fabr.)	Coleoptera	Coccinellidae	38	Predator (Rice pest)
<i>Micraspis univittata</i> Hope	Coleoptera	Coccinellidae	2	Predator (Rice pest)
<i>Paederus fuscipes</i> (Curtis)	Coleoptera	Staphylinidae	12	Predator (Rice pest)
<i>Paederus melampus</i> Er.	Coleoptera	Staphylinidae	3	Predator (Rice pest)
<i>Nala lividipes</i> (Dufour)	Dermaptera	Carcinophoridae	4	Predator (Rice pest)
<i>Anatrichus pygmaeus</i> Lamb	Diptera	Chloropidae	1	Predator (Rice pest)
<i>Tytthus parviceps</i> Reuter	Hemiptera	Miridae	2	Predator (Rice pest)
<i>Tropiconabis capsiformis</i> Germaar	Hemiptera	Nabidae	3	Predator (Rice pest)
<i>Amyotea malabarica</i> Fab	Hemiptera	Pentatomidae	3	Predator (Rice pest)
<i>Agrionemys pygmaea</i> Rambur	Odonata	Coenagrionidae	4	Predator (Rice pest)
<i>Ichneura aurora</i> (Brauer)	Odonata	Coenagrionidae	5	Predator (Rice pest)
<i>Brachythemis contaminata</i> Fabr.	Odonata	Libellulidae	4	Predator (Rice pest)
<i>Ictinogomphus rapax</i> Rambur	Odonata	Libellulidae	2	Predator (Rice pest)
<i>Orthetrum sabina</i> (Drury)	Odonata	Libellulidae	12	Predator (Rice pest)
<i>Potamarcha obscura</i> Rambur	Odonata	Libellulidae	5	Predator (Rice pest)
<i>Urothemis signata</i> Rambur	Odonata	Libellulidae	5	Predator (Rice pest)
<i>Ceragrion coromandelianum</i> Fabr.	Odonata	Agriidae	8	Predator (Rice pest)
<i>Conoccephalus longipennis</i> deHaan	Orthoptera	Tettigoniidae	9	Predator (Rice pest)
<i>Cheriacanthium</i> sp.	Araneae	Clubionidae	2	Predator (Rice pest)
<i>Monomorium</i> sp.	Hymenoptera	Formicidae	8	Predator (Rice pest)
<i>Luperodes</i> sp.	Coleoptera	Chrysomelidae	1	Unknown
<i>Scatella</i> sp.	Diptera	Ephydriidae	2	Unknown
<i>Exitianus nanus</i> (Dist.)	Hemiptera	Cicadellidae	2	Unknown
<i>Sardia rostrata</i> Melichar	Hemiptera	Delphacidae	1	Unknown
<i>Rhinocoris fuscipes</i> Fab.	Hemiptera	Reduviidae	2	Unknown
<i>Sirthenia flavipes</i> Stal.	Hemiptera	Reduviidae	2	Unknown
<i>Pinobius indicus</i> Kraatz	Coleoptera	Staphylinidae	2	Unknown
<i>Pinophilus depressus</i> Kraatz	Coleoptera	Staphylinidae	1	Unknown

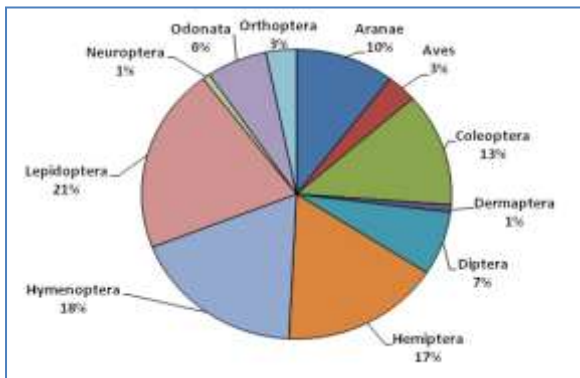


Fig-1 Relative diversity of different taxa visiting rice panicle

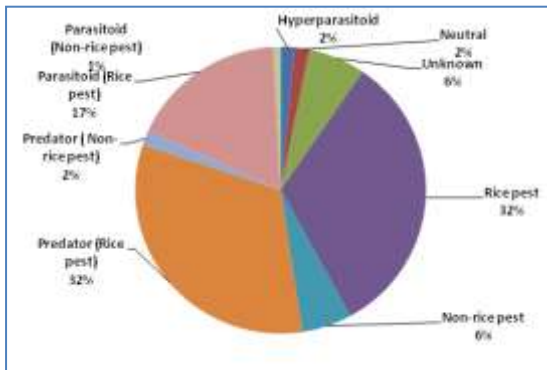


Fig-2 Guild structure of fauna recorded on rice panicle

Discussion

In term of guild structures, the finding was closely similar to previous study by Heong et al. [16] and Schoenly et al. [17] where they recorded highest number of pest followed by predators and parasitoids. In the present study restricted to panicles only the composition of pests and predators was similar. The high number of pest in the field may have contributed to the high number of predators in rice field. During flowering stage, the rice field provides additional niches for insects. Ogah and Nwilele [18] observed many species of insects those feed on rice panicles in Nigeria. Some of them feed on pollen, stamens and pistils of rice when the glumes open; others feed on the floral parts of the rice plant. The panicle thrips, *Haplothrips* spp., feed on the rice inflorescence, damaging the lemma and the palea. Branco et al., studied the assemblage of granivorous birds in the paddy fields of Brazil and recorded a total of 10 species, distributed among 5 families [19]. In the present study only three species belonging to three families were recorded. Because rice is usually considered as a self-and wind pollinated plant, the importance of flower visitation by insects has largely been ignored but focused on wind. Pu et al. [8] characterized the insects visiting rice plants during anthesis and considered the effects of insect pollination on gene flow. They conducted a nationwide survey in China and identified more than 510 insect species that visited rice flowers. Honeybees, such as *Apis dorsata* F., *Apis florea* Fabricis, *Apis mellifera* L. and *Apis cerana cerana* F., hoverflies and several other species carried large amounts of pollen. In the present study only 126 species of organisms were recorded to visit rice panicle as the study was undertaken in a limited area. In the present study, only the wild honeybee *A. dorsata* was observed to forage on rice flowers and others species were not observed as reported in China.

Conclusion

The results of this study indicate that a wide array of organisms visit rice panicles which include both rice and non-rice species. The guild structure also indicated that pests and natural enemies visited the rice panicle in good numbers.

Application of research: The information on rice panicle fauna will be helpful for decision making with regard to control measures at flowering stage of the crop. Furthermore, it will serve as basic information for formulating integrated pest

management strategy in rice.

Research Category: Pest management

Abbreviations:

NRRI: National Rice Research Institute

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Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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