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Savita Chakradhari
Research Scholar Zoology, Govt. P.G. College, Satna, Madhya Pradesh, India

Dr. Rajeev Tiwari
Assistant Professor, Department of Zoology, Govt. P.G. College, Satna, Madhya Pradesh, India

Corresponding Author:
Savita Chakradhari
Research Scholar Zoology, Govt. P.G. College, Satna, Madhya Pradesh, India

Insect diversity of the Mukundpur Tiger reserve, Satna (M.P.)

Savita Chakradhari and Dr. Rajeev Tiwari

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Abstract
An inventory of species diversity of insects of the Mukundpur Tiger Reserve, Satna (M.P.). Small insects with the soft body were collected by hand with the help of a fine camel hair brush and forceps, and then preserved in 70% alcohol by dipping the soft brush into the medium. Sweeping nets were used to collect the insect from plants. A long stick was used for beating the plants harboring insects. A big size cloth is spread over the ground to collect the falling insects. Total recorded aquatic insect sp. distribution was expressed in higher to lower order as Coleoptera (36), Hemiptera (22), Odonata (11), Diptera (6), Ephereoptera (4), and Trichoptera (2). Aquatic insect Order as per the comparative evaluation Coleoptera was found in utmost count compared through Hemiptera, Odonata, Diptera, Ephemeroptera, and Trichoptera. The order Coleoptera consist (45%), Hemiptera (27.16%), Odonata (13.58%), Diptera (7.40%), Ephereoptera (4.90%), and Trichoptera (2.46%) from observed aquatic insect species. MKPTSR is a well-distinguished place intended for the affluence of coleopteran fauna.

Keywords: Insects, diversity, mukundpur tiger reserve, Satna

1. Introduction
Insects are the chief constituent of the world's biodiversity. Quantitatively, insects are important pointers for species-rich ecological areas. Insects appear to be the most fluctuated gathering of animals on earth, comprising for 75% of all known species in wording with both logical wealth and biological system measures. Insects are the most varied group found in the terrestrial and aquatic habitats. Insects inhabiting water in favor of entire or part of life to complete their life cycle are universally called aquatic insects, which comprise a small portion of the total insect's assortment. Qualitatively they are also imperative, whether the subjects of conservation themselves or as implements for identifying biotic regions with elevated endemism. The indices of diversity point toward that this stream has a good equilibrium insect population that has the benefit of a smooth illustration of some species demonstrating the active character of the ecosystem. Insects (aquatic) characterize less than 1% of total animal diversity.

Insects compose key pointers that allow the monitoring of the impact of the environment on biodiversity, responding delicately to transforms in habitat extent and superiority and to altered organization practices correlated with the atmosphere (Clarke *et al*., 2008 and Jaganmohan *et al*., 2012) [1-2].

There are more than 30 million species globally, with generally 1.4 million of them having been momentarily depicted. In specific freshwater biota, fewer than 3% of all insect species have a sea-going lifecycle. India is surrounded by the world's 12 mega-varied countries, on behalf of practically 7% of the globe's Insect fauna (Gadgi, 1996) [3]. Current evaluations indicate that India has approximately thousands of native insect species. The north-eastern states, the mountain range, and the Andaman and Nicobar Islands contain more insect variety, just as a high biodiversity assessment. Atmosphere misfortune, on dim, tainting, packing, and the chance of anthropogenic environmental change are for the most part adding to the elimination of insects. Insects contribute more partially of all the proofed species along with above three fourth of the estimate assortment, in the ground (Hammond, 1992, Buskirk *et al.* 1993 and Smija and Nagendra, 2002) [4-6].

The distribution among beetles in a given ecosystem is determined by a variety of parameters, its most crucial of those are necessary to feed and environmental conditions (Allan *et al*.,

1973) [7]. Climate, ambient temperature, water, dryness, changes in the supply of food materials, and foliage are all elements that cause seasonal changes (Anu, 2006; Anu, 2009; Shanthi *et al*., 2009) [8-10]. Insect migration, colonization, persistence, availability, activity, viability, and sexual habits are all influenced by abiotic elements. The irrationality of these characteristics restricts insect species' geographic distribution, either by imposing ends or by restricting the range of host plants or animals.

2. Material and Methods

2.1 Study area

In Madhya Pradesh, India, the Mukundpur Range is situated in the Amarpatan Tehsil of the Satna area. In Mukundpur, the first historically speaking White Tiger Safari is assembled. Mukundpur zone covers the current Mukundpur area of the Satna backwoods division and furthermore is situated inside 24°11'35" N to 24°26'25" N in scope and 81°6'35" E to 81°22'20" E in longitude.

2.2 Sampling methods apply

The present study was carried out during the all three climates, including two regular years 2018-2020 followed by three specify sampling methods.

2.3 Implementation of the Study

Aquatic and terrestrial areas of MKPTSR were allowed with the implementation of suitable procedures.

1) Collected sample bottles labeled to be identified.
2) Catching insects commence from 010:00 am to 20:00 am with nets.
3) Initial and final temperatures were measured.
4) References are used as references for identification were Youdeowei (1997) [11], Bernard (1982) [12], Larsen (2005) [13] and Terren *et al.* (2012) [14].

2.4 Collection Methods

Small insects with the soft body were collected by hand with the help of a fine camel hair brush and forceps, and then preserved in 70% alcohol by dipping the soft brush into the medium. Sweeping nets were used to collect the insect from plants. A long stick was used for beating the plants harboring insects. A big size cloth is spread over the ground to collect the falling insects.

3. Results

3.1 MKPTSR insects' diversity studies

MKPTSR insects' diversity was studied, covered terrestrial and aquatic insect populations. Insect diversity exists as a component of the food chain and unidirectional energy flow. In the present investigation, aquatic insect diversity of MKPTSR exposed the presence of 82 sp. (Table 1).

Table 1: Insect diversity of MKPTSR with the order, family and species.

Order	Family	Species
Coleoptera	Carabidae [4] (ground beetles)	*Lymnaeum nigropiceum*
		Casnoidea sp.
		Oeydromus streinbuehleri
		Chlaenius sp.
	Dyticsidae [13]	*Hydatics fabricii fabricii Machley*
		Hydrovatus sp
		Hydrovatus ovatus sp
		Laccophilus elegans sharp
		Laccophilus inefficiens walker
		Laccophilus anticatus anticatyus sharp
		Potamonecteus sp.
		Dytiscus latissimus
		Clypeodytes sp.
		Cybister tripunctatus asiaticus sharp
		Cybister sugillatus
		Cybister explanatus
		Cybister brenis
	Gyrinidae [7]	*Dineutus (spinosodineutus) unidenttatus Aube*
		Gyrinus hydrochidae
		Gyrinus haliplidae
		Gyrinus noteridae
		Gyrinus dytiscidae
		Gyrinus hydrophilidae
		Gyrinus sericeolimbatus
	Hydrophilidae [9]	*Hydrophilus olivaceus fab*
		Hydrophetus acumenatus
		Hydrophilus Triagunlaris
		Cercyon sp.
		Sternolophus rufipes fab
		Helochares sp.
		Enochrus esuriens walker
		Laccobius sp.
		Amphiops sp.

	Noteridae	*Hydrocanthus sp.*
		Neohydrocoptus subvittulus mots
		Canthydrus laetabilis walker
	Dryopidae	*Dryopida sp.*
	Psephenidae	*Psephenida sp.*
Diptera [4]	Coulidae	*Culex sp.*
		Anophles sp.
	Chronomidae	*Chironomous sp.*
		Chironomous Hippoboscidae
	Thaumaleidae	*Thaumaleidae sp.*
	Chaboridae	*Chaboridae sp.*
Hemiptera [9]	Corixidae	*Micronecta scuttellaris Stal*
		Micronecta punctata Horvarth
		Micronecta corixa punctata
	Hydrometerdae	*Hydrometraustralis sp.*
		Hydrmetra vittata stal
		Hydrometra butleri hungerford and evans
		Hydrometridae bacilipmetra
		Hydrochaetometra sp.
		Dolichocephalometra sp.
	Belostomatidae	*Lethocerus indicus lepeleiter*
		Diplonychus rusticus fabricius
		Diplonychus annulatus fabricius
	Gerridae	*Gerris gracilicornis Horvath*
		Neogeris parvulus Stal
		Rhyacobates sp.
	Vellidae	*Microvelia sp.*
	Ranatridae	*Ranatra sp.*
	Notonectidae	*Anisop sp.*
		Notonecta sp.
	Nepidae	*Ranatra filiformes Fabricius*
		Laccotrephes ruber Linnaeous
	Pleidae	*Plea liturata fiebr*
Odonata [5]	Libellulidae	*Orthetrum sp.*
		Orthetrum sabina sabina sp.
	Aeshnidae	*Anax guttatus Burmeister*
	Coenagrionidae	*Ischnura senegelensis Rumber*
		Ischnura aurora aurora Brauer
		Ceriagrion olivaceum Laidlaw
		Oncychargio atrocyana Selys
		Agriocnemis pygmaea Rumbra
	Gophidae	*Gophidae sp.*
	Macromiidae	*Macromiida sp.*
Tricoptera [2]	Calamoceratidae	*Calamoceratida sp.*
	Glososomatidae	*Glososomatida sp.*
Ephemeroptera [3]	Ephemerellidae	*Ephemerellida sp.*
	Leptophlebiidae	*Leptophlebiidae sp.*
	Baetidae	*Cloeon sp.*
		Baetis sp.

During the survey, an observational study of 28 families of aquatic insects was examined. Both ecosystems (terrestrial and aquatic) of MKPTSR contain 6 orders Coleoptera, Diptera, Hemiptera, Odonata, Ephemeroptera, and Trichoptera. Among these orders, Coleoptera was recorded with the maximum population.

Coleoptera was found out in high populations involve 36 sp. embracing of 5 families. Order Hemiptera of aquatic insect consist of 22 sp. along with 9 families. Diptera showed their availability with 4 families and 6 sp. Odonata order appeared with 5 families and 9 sp. Ephemeroptera populations were observed with 4 sp. including 3 families, similarly, the Trichoptera order contains 2 specific families with their respective species (Table 1).

3.2 Aquatic insect sp. distribution

Total recorded aquatic insect sp. distribution was expressed in higher to lower order as Coleoptera (36), Hemiptera (22), Odonata (11), Diptera (6), Ephereoptera (4), and Trichoptera (2). Aquatic insect Order as per the comparative evaluation Coleoptera was found in utmost count compared through Hemiptera, Odonata, Diptera, Ephemeroptera, and Trichoptera (Fig 1).

The order Coleoptera consist (45%), Hemiptera (27.16%), Odonata (13.58%), Diptera (7.40%), Ephereoptera (4.90%), and Trichoptera (2.46%) from observed aquatic insect species (Fig 1). Frequently known Coleopterans (beetles) compose the chief order, the ecological impact of beetles' outcomes from their consequences on green plants, their input to the

breakdown of plant and animals' remains, and their rapacious activities. MKPTSR is a well-distinguished place intended for the affluence of coleopteran fauna.

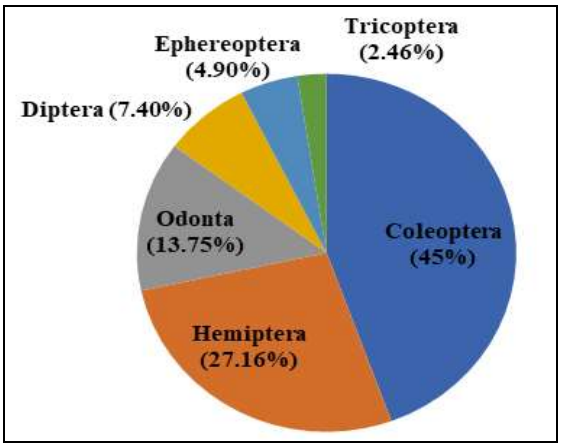

Fig 1: Percentage of different Insect orders.

Coleopteran orders were including 5 families *Dyticsidae, Hydrophilidae, Gyrinidae, Carabidae*, and *Noteridae*. Family *Dyticsidae* has constituted 13 sp. *Hydatics fabricii fabricii Machley, Hydrovatus sp., Hydrovatus ovatus sp, Laccophilus elegans sharp, Laccophilus inefficiens walker, Laccophilus anticatus anticatyus sharp, Potamonecteus sp., Dytiscus latissimus, Clypeodytes sp., Cybister tripunctatus asiaticus sharp, Cybister sugillatus, Cybister explanatus* and *Cybister brenis sp.* (Table 1).

The Hydrophilidae family of Coleopteran have constituted 9 sp. *Hydrophilus olivaceus, fab Hydrophetus acumenatus, Hydrophilus Triagunlaris, Cercyon sp. Sternolophus rufipes fab, Helochares sp., Enochrus esuriens walker, Laccobius sp.*, and *Amphiops sp.*

Gyrinidae family of Coleoptera included 7 sp. namely *Dineutus (spinosodineutus) unidenttatus Aube, Gyrinus hydrochidae, Gyrinus haliplidae, Gyrinus noteridae, Gyrinus dytiscidae, Gyrinus hydrophilidae* and *Gyrinus sericeolimbatus sp.* (Table 1).

Carabidae (Coleoptera) were containing 4 sp. likewise *Lymnaeum nigropiceum, Casnoidea sp. Oeydromus streinbuehleri, Chlaenius sp. Similarly, Noteridae (Coleoptera) were accounted for with 3 sp. Hydrocanthus sp., Neohydrocoptus subvittulus mots, Canthydrus laetabilis walker sp.* (Fig 2).

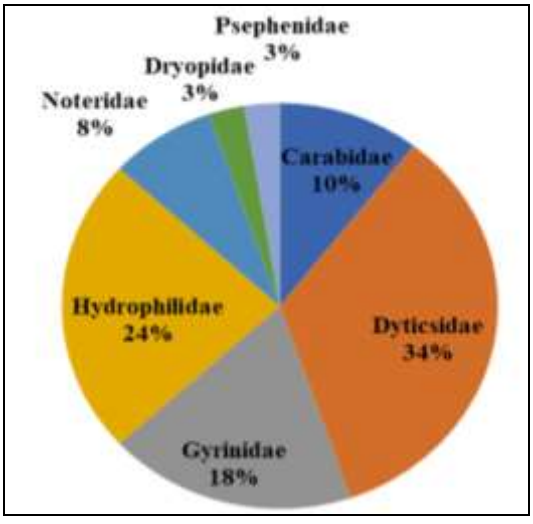

Fig 2: Coleoptera (order) families percentage.

4. Discussion

Insect diversity helps to shed some light on understanding some aspects of the structural components of ecosystems. This study shows that the aquatic and terrestrial are dominated by insect diversity. Both system result of this observation shows that the both habitat is dominated by insect diversity. It is obvious that both habitats, though it was a mman-mademof odified land, were reported to have a rich variety of entomofauna. The rich number of species available in the aquatic habitat was foremost because of the availability of varieties of plants and microhabitats. The systems, though it was a man-made modified land, reported having a rich variety of entomofauna. The species number richness in the land was mainly since of the accessibility of varieties of plants in addition to microhabitats.

Larvae of some Coleoptera and Diptera rely on the intracellular air spaces for respiration and are thus limited in their distribution to some particular macrophytes hosts. The present study clearly shows that the water quality of MKPTSR is good, unpolluted, and the MKPTSR has a diverse macrophytes species which can shelter a large variety of insect populations. As a result, the MKPTSR ecosystem is self-sustaining and can be useful for deriving economic gain in terms of fishing and cultivation by the neighboring human population.

Kumar and Nath (2003) [15] identified 23 insect species from six orders and twenty families that attacked pigeonpea (*Cajanus cajan*). Korpela *et al.* (2015) [16] performed systematic research to assess the nature of destruction and pest status of different insect groups involved in multiple foliage injuries to *Paulownia fortunei* . They discoveredthree pentatomid bugs, observed an increase in the number of pumpkin caterpillars, *Margaronia indica* (Saunders), *Diaphania indica* (Saunders), and *Palpita indica* minor pests in bitter gourd, *Momardica charantia Lin.*, little gourd, *Coccinnia coccinia wight an Aronott*), and pointed gourd, Tricho. Dolycoris indicus, *Nezara viridula*, and *Erthesino fullo* infest the plant paviowani, which was discovered to be the first host plant of these species in the country. *Dolycoris indicus* and *Nezara viridula* have shown a greater level of infection in *Paulownia*, whereas *Erthesino fullo* has sometimes visited Paulownia. These bugs were discovered to be responsible for the wilting of some plant juvenile tips.

Schizanthus (*Solanaceae*) features zygomorphic blooms and includes twelve species of yearly or bennial plants that are mostly disturbed in Chile and characterized by month-to-month pollination. Tangmitcharoen *et al.*, (2006) [17] identified lepidopterans such as the *Danaidae, Hesperiidae, Nymphalidae, Papilionidae,* and *Pieridae* as possible pollinator insects in the canopies of natural and planted forest trees near the merging seed plantation.

The study by Takhelmayum and Gupta (2011) [18] on the distribution of aquatic insects in Loktak Lake, Manipur, revealed 7 insect species. Jana *et al.*, (2009) [19] also recorded 20 species of insects from a weed-infested pond in West Bengal. A similar pattern of insect composition is also noticed from the work of Jaiswal (2013) [20], who recorded 31 species of Coleoptera and 14 species of Hemiptera in lakes around Hyderabad. Hymenoptera establish work concern to Indian province was studies specifically on species found in different regions.

Singh and Borana (2008) [21] discovered 12 species of Coleoptera, 8 species of Hemiptera and Odonata, 5 species of Diptera, 4 species of Ephemeroptera, and a single variety of

Trichoptera in a Bhopal lake habitat. Hemipteran and Coleopteran arthropod supremacy indicated a less contaminated wetland (Majumdar *et al.*, 2013) [22]. As a result, the MKPTSR ecology is significantly less contaminated due to the prevalence of Hemiptera and Coleopteran insects.

5. Conclusion

The study concluded that the diversity of insects is closely associated with our lives and directly or indirectly provides benefits to humanity in diverse ways. Numbers of insect species become extinct or extirpated from the local habitats of MKPTSR. Insect diversity exists as a component of the food chain and unidirectional energy flow. In the present investigation, aquatic insect diversity of MKPTSR exposed the presence of 82 sp.

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