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Status of aquatic insect species of the Mukundpur Tiger reserve, Satna (M.P.)

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Abstract
An inventory of aquatic insect species of the Mukundpur Tiger Reserve, Satna (M.P.). Some insects are flightless and hence vulnerable to habitat fragmentation or environmental transformation. Because of their small size, short life spans, and high reproductive rates, the abundances of many species can transform through several orders of extent on a seasonal or annual time scale, minimizing time lags among situational transforms and population modification to new circumstances. Insect diversity and distribution response to environmental change that can directly affected the ecological unit, structure, and functions. Changes are easily detectable and create insects more functional as indicators of atmosphere changes than are larger or longer-lived organisms that respond more slowly.

Keywords: Aquatic insect, Mukundpur tiger reserve, Satna

Introduction
Entomology is being exhausted because of living space misfortune. Insect's assortment and the measure of food and living space needed by Insects are diminished because of broad farming exercises. Unfamiliar types of Insects are shipped to new places through worldwide trade and relocation, disturbing neighborhood biological systems. Pesticide abuse can unfavorably affect semi Insect populaces. Changing environment additionally represents various dangers to insect presence, including modifying life cycles and geographic reaches, constraining the plants that insects devour, and expanding the danger of warmth waves and dry spells. A few butterflies, just as explicit honey bees and insects, have seen diminishes in certain spots, prominently in Europe and the United Kingdom. Some insect assortments have been demonstrated to be on the ascent in different areas, as per research. Be that as it may, we simply don't know adequately in numerous spaces and for some kinds of insects. Insects occur in diverse natural niches of land and water, they possibly enduring and or temporary inhabitants.

Trees and plants provide essential habitat for small species such as small mammals, birds, and insects, and even minor changes on a micro-ecological scale, such as the addition of a few plants, can result in significant increases in insect recruitment (Sperling, and Lortie, 2010) [1]. Furthermore, whereas individual green habitats are often small and dispersed, green habitat networks can be rather broad, allowing for significant habitat linkage to aid species migration and operation while also increasing biodiversity in neighboring areas (Fernandez and Jokimaki, 2001) [2].

The number, variety, and distribution of insect taxa in established forests are studied, with the goal of determining the factors that influence insect dispersion. Except for genera of highly hybridized plants, herbs and creepers were also identified at the species level in portions of green environments. Because they were occasionally planted in dense clusters, it was impossible to precisely record the numbers of individuals; number of individuals belonging to these categories, but just documented their presence/absence. The abundance and diversity of insects appear to be shaped by a number of variables. Scanlon and Petit (2008) [3] investigate the variety and biomass of nocturnal aerial insects in an Adelaide City park, as well as bat habitat recommendations. The diversity distribution of bee and butterfly species was also determined (Matteson and Langellotto, 2010) [4]. The richness of insects contributes significantly to the safeguarding of biological systems. As a result, our general public is increasingly in need of well-organized data administrations, particularly for phylogeny analysis, in order to achieve a more earth-capable tomorrow.

The insect communities (abundance) within the Mukundpur tiger reserve (MKPTSR) are not studied and there is no documentation of the insect fauna in this reserve.

The categorization of insects is such a vast assemblage that it poses great difficulties for taxa recognition and lead to additional taxonomic uncertainties.

Material and Methods

Study area

In Madhya Pradesh, India, the Mukundpur Range is situated in the Amarpatan Tehsil of the Satna area. In Mukundpur, 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.

Sampling methods apply

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

Implementation of the Study

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

1. Collected sample bottles labeled in order to be identified.
2. Catching insects commence at 010:00 am to 20:00 am with nets.
3. Initial and final temperatures measured.
4. References are used as references for identification were Youdeowei (1997) [5], Bernard (1982) [6], Larsen (2005) [7] and Terren *et al.* (2012) [8].

Hand collection Pinning and Pickled specimens

- Insects were directly collected by hand though wearing of gloves and transferred in killing bottles. The insects were processed for pinning and preserved in wooden insect box in dry condition and further allowed for identification.
- The dead insect was removed from the killing bottle and placed on a setting board. The insect was mounted by inserting an entomology pin symmetrically positioned through the thorax, in such a way that three quarter of the pin passes through the insect. The fore and hind wings were then properly sprayed out at 90°. This method was applicable to large insects.
- Setting of insect; insect captured were set such that their wings and legs were spread in a horizontal position on a standard setting board and held in position by a setting tape. Then pinned insect was allowed to dry for two days before mounting on the insect box.
- Specimens that cannot be pinned were pickled in tubes containing fluid preservative. In this research a 50% ethanol (alcohol) was prepared as a preservative for pickled specimen.

Results

The survey was performed for three seasons for years 2018-19 and 2019-20. Status of aquatic insect species was recorded in terms of dominant, subdominant, recedent, subrecedent, Eudominant respectively. During 2018-19 total of 1857 sp. was represented with subdominant status (Fig 1). Total 3926 aquatic sp. expressed with the status of recedent, whereas 676 sp. was accounted under subdominant status during 2018-19. There was no sp. was enrolled as dominant and eudominant. There were only 3 subdominants aquatic sp. was recorded as *Culex* sp. (203), *Anopheles* sp. (237), and *Chironomous Hippoboscidae* sp. (236). Diptera order of *Coulidae* and *Chronomidae* families completely expressed with aquatic subdominant status. Similarly aquatic *Carabidae* family of Coleoptera consists of 4 families with 0.63, 0.56, 0.50, and 0.82% as aquatic subrecedent dominant status. *Gyrinidae* family consist of 7 sp. with 1.15, 1.12, 1.43, 1.39, 1.52, 1.00, and 1.13% as aquatic recedent dominant status.

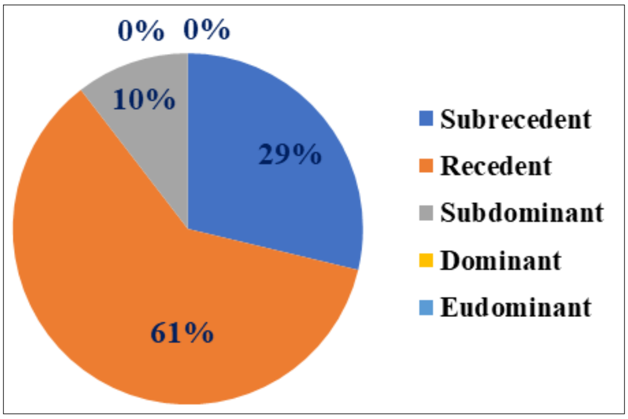

Fig 1: Percentage of aquatic insect dominant status during 2018-19 in MKPTSR.

Table 1: Aquatic insect population with relative abundance and dominant status in MKPTSR during 2019-20.

Order	Family	Species	Insects No.	RA%	Dominant Status
Coleoptera	Carabidae [4] (ground beetles)	*Lymnaeum nigropiceum*	52	0.78	Subrecedent
		Casnoidea sp.	45	0.68	Subrecedent
		Oeydromus streinbuehleri	42	0.63	Subrecedent
		Chlaenius sp.	62	0.93	Subrecedent
			201		
	Dyticsidae [13]	*Hydatics fabricii fabricii Machley*	86	1.29	Recedent
		Hydrovatus sp	84	1.26	Recedent
		Hydrovatus ovatus sp	73	1.10	Recedent
		Laccophilus elegans sharp	91	1.37	Recedent
		Laccophilus inefficiens walker	89	1.34	Recedent
		Laccophilus anticatus anticatyus sharp	74	1.11	Recedent
		Potamonecteus sp.	69	1.04	Recedent
		Dytiscus latissimus	73	1.04	Recedent
		Clypeodytes sp.	74	1.11	Recedent
		Cybister tripunctatus asiaticus sharp	83	1.25	Recedent
		Cybister sugillatus	73	1.10	Recedent
		Cybister explanatus	87	1.31	Recedent

		Cybister brenis	82	1.29	Recedent
			1038		
	Gyrinidae [7]	*Dineutus (spinosodineutus) unidenttatus Aube*	81	1.22	Recedent
		Gyrinus hydrochidae	67	1.01	Recedent
		Gyrinus haliplidae	84	1.26	Recedent
		Gyrinus noteridae	74	1.11	Recedent
		Gyrinus dytiscidae	89	1.34	Recedent
		Gyrinus hydrophilidae	71	1.07	Recedent
		Gyrinus sericeolimbatus	80	1.20	Recedent
			546		
	Hydrophilidae [9]	*Hydrophilus olivaceus* fab	91	1.37	Recedent
		Hydrophetus acumenatus	92	1.39	Recedent
		Hydrophilus Triagunlaris	82	1.23	Recedent
		Cercyon sp.	89	1.34	Recedent
		Sternolophus rufipes fab	88	1.32	Recedent
		Helochares sp.	67	1.01	Recedent
		Enochrus esuriens walker	69	1.04	Recedent
		Laccobius sp.	90	1.36	Recedent
		Amphiops sp.	75	1.13	Recedent
			743		
	Noteridae	*Hydrocanthus* sp.	64	0.96	Recedent
		Neohydrocoptus subvittulus mots	70	1.05	Recedent
		Canthydrus laetabilis walker	70	1.05	Recedent
			204		
Diptera	Coulidae	*Culex* sp.	190	2.87	Recedent
		Anophles sp.	233	3.52	Subdominant
			423		
	Chronomidae	*Chironomous Hippoboscidae*	190	2.87	Recedent
	Thaumaleidae	*Thaumaleidae* sp.	125	1.88	Recedent
	Chaboridae	*Chaboridae* sp.	147	2.22	Recedent
Hemiptera	Corixidae	*Micronecta scuttellaris* Stal	102	1.54	Recedent
		Micronecta punctata Horvarth	93	1.40	Recedent
		Micronecta corixa punctata	84	1.26	Recedent
			279		
	Hydrometerdae	*Hydrometraustralis* sp.	79	1.19	Recedent
		Hydrmetra vittata stal	86	1.29	Recedent
		Hydrometra butleri Hungerford and evans	91	1.37	Recedent
		Hydrometridae bacilipmetra	99	1.49	Recedent
		Hydrochaetometra	89	1.34	Recedent
		Dolichocephalometra	76	1.14	Recedent
			520		
	Belostomatidae	*Lethocerus indicus lepeleiter and serville*	84	1.26	Recedent
		Diplonychus rusticus fabricius	94	1.42	Recedent
		Diplonychus annulatus fabricius	98	1.48	Recedent
			276		
	Gerridae	*Gerris gracilicornis Horvath*	196	2.96	Recedent
		Neogeris parvulus Stal	147	2.22	Recedent
		Rhyacobates sp.	78	1.17	Recedent
			347		
	Vellidae	*Microvelia* sp.	43	0.64	Subrecedent
	Ranatridae	*Ranatra* sp.	68	1.02	Recedent
	Notonectidae	*Anisop* sp.	91	1.37	Recedent
		Notonecta sp.	77	1.16	Recedent
	Nepidae	*Ranatra filiformes Fabricius*	68	1.02	Recedent
		Laccotrephes ruber Linnaeous	75	1.13	Recedent
	Pleidae	*Plea liturata fiebr*	74	1.11	Recedent
			496		
Odonata	Libellulidae	*Orthetrum* sp.	74	1.11	Recedent
		Orthetrum sabina sabina sp.	79	1.19	Recedent
			153		
	Aeshnidae	*Anax guttatus Burmeister*	51	0.77	Subrecedent
		Cephalaeschna sp.	55	0.83	Subrecedent
			106		
	Coenagrionidae	*Ischnura senegelensis Rumber*	70	1.05	Recedent
		Ischnura aurora aurora Brauer	61	0.92	Subrecedent
		Ceriagrion olivaceum Laidlaw	60	0.90	Subrecedent

		Oncychargio atrocyana Selys	73	1.10	Recedent
		Agriocnemis pygmaea Rumbra	49	0.74	Subrecedent
			313		
	Gophidae	*Gophidae* sp.	69	1.04	Recedent
	Macromiidae	*Macromiida* sp.	60	0.90	Subrecedent
			129		
Tricoptera	Calamoceratidae	*Calamoceratida* sp	50	0.75	Subrecedent
	Glososomatidae	*Glososomatida* sp.	49	0.74	Subrecedent
			99		
Ephemeroptera	Ephemerellidae	*Ephemerellida* sp.	55	0.83	Subrecedent
	Leptophlebiidae	*Leptophlebiidae* sp.	72	1.08	Recedent
			127		
	Baetidae	*Cloeon* sp	27	0.40	Subrecedent
		Baetis sp	28	0.42	Subrecedent
			55		
Total species 6617					

The study was carried out intended for three periods of 2019-20 along with variable status. Aquatic insect species' dominant status was evidenced in terms of dominant, subdominant, recedent, subrecedent, Eudominant. During 2019-20 total of 5531 aquatic sp. was represented with recedent status (Table 1). Total 853 no.s of aquatic sp. expressed with the status of subrecedent, whereas 233 sp. was accounted under aquatic subdominant status during 2019-20. There was no sp. was enrolled as dominant and eudominant. *Corixidae* family of order Diptera was expressed 1.54, 1.40, and 1.26% with aquatic recedent dominant status. Diptera order of *Coulidae* and *Chronomidae* families completely expressed with aquatic subdominant status. Similarly *Carabidae* family of Coleoptera consist 4 families with 0.78, 0.68, 0.63, and 0.93% as aquatic subrecedent dominant status (Fig 2). *Gyrinidae* family consist of 7 sp. with 1.22, 1.01, 1.26, 1.11, 1.34, 1.07, and 1.20% as recedent dominant status. *Hydrophilidae* family was accounted as 9 aquatic sp. with 1.37, 1.39, 1.23, 1.34, 1.32, 1.01, 1.04, 1.36, and 1.13% as recedent status.

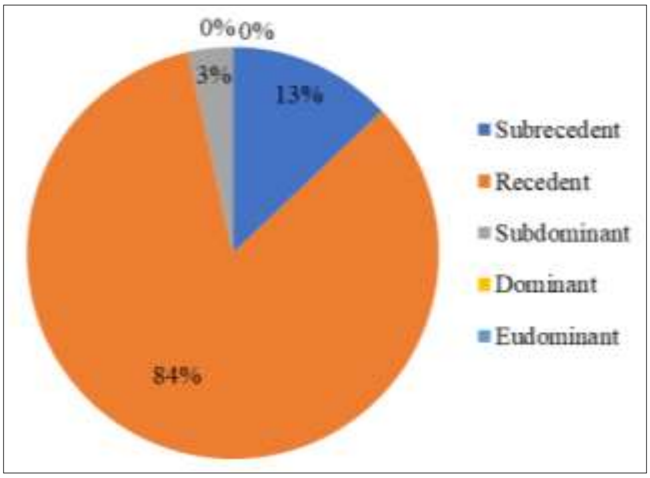

Fig 2: Percentage of aquatic insects dominant status during 2019-20 in MKPTSR.

Discussion

Tara *et al.*, (2011) [9] observed the maximum number of Coleoptera during the winter in the Gharana wetland of Jhammu, India, which was in agreement with the present investigation. The present study on seasonal variation of insects in the MTPTSR is also in agreement with the findings of Singh and Borana (2008) [10]. They found a similar pattern of abundance of aquatic insects in which Coleoptera, Diptera, and Hemiptera are mostly abundant during winter in the Lower Lake of Bhopal. The presence of the highest population of Hemiptera during winter in the MKPTSR during the study period established a close relationship with the findings of Das and Gupta (2012) [11]. Morphological and molecular characterization of *Apanteles mohandasi* Sumodan and Narendran (Hymenoptera) were documented (Gupta *et al*., 2011) [12].

A decline in the abundance of aquatic insects in the monsoon period may be due to the water dynamics of the MKPTSR caused by the inflow of rain and flood water into the MKPTSR. Water dynamics affect the insects' stability, disturbing their habitat, growth and proliferation, in spite of nutrient input into the MKPTSR along with the water flow. This was in agreement with the findings of Sarma and Baruah (2013) in their study on wetlands in Guwahati city. The study recorded a reduction in insect abundance in the summer in the MKPTSR area. The reduction was attributed to a lack of inflow of nutrients as the water level of the catchment area was considerably reduced and the utilization of existing nutrients in the MKPTSR by already developed insect populations.

Conclusion

Aquatic insect population status with seasonal changes in MKPTSR, in investigation period it was observed that most of the aquatic insect were most in winter and observed lowest in the rainy. The results were obtained from most to less abundance of order as expressed. In summer climate, order Coleoptera expressed as *Dytiscidae* (350) > *Hydrophilidae* (218) > *Gyrinidae* (140) > *Nooteridae* (71) > *Carabidae* (47). In rainy season Coleoptera status was expressed as *Dytiscidae* (251) > *Hydrophilidae* (167) *Gyrinidae* (128) > *Carabidae* (50) > *Nooteridae* (49). In winter season Coleoptera aquatic insect population status order was expressed as Dytiscidae (480) > *Hydrophilidae* (329) > *Gyrinidae* (251) > *Nooteridae* (116) > *Carabidae* (58).

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