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RESEARCH ARTICLE

BIODIVERSITY OF CHIRONOMIDAE (DIPTERA) FROM UDAIPUR REGION (INDIA)

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Abstract

Present study was conducted at four sampling sites *viz.*: Fatehsagar Lake, Pichola Lake, Udaisagar Lake and Ayad River at Udaipur region, India. Biodiversity analysis of Chironomids up to generic level showed that Chironomids are most diverse at Udaisagar Lake. Udaisagar provides dominant site for Chironomids. Complete dominance of Chironominae in all four sampling sites is related to their adaptability and survival in low oxygen environments due to presence of hemoglobin analog in their bodies. Genus *Chironomus* was found to be absent in Fatehsagar and Pichola Lake. This study also refutes the myth that every red colored larvae collected for study of polytene chromosome in this area is *Chironomus.*

Introduction:-

Chironomids, often called non-biting midges or blind mosquitoes, are abundant and widespread aquatic insects. These insects spend the greatest part of their life cycle in larval form, occupying a wide range of habitats. Chironomids are one of the most dominant, widespread and diverse aquatic invertebrate taxa in freshwater systems (Armitage *et al* 1995). Chironomids are distributed from the Arctic to the Antarctic and from the seas to permanent snowfields. Chironomids live in the glaciated areas of the highest mountains, including an elevation up to 5600 meters in the Himalaya (Kohshima 1984; Saether & Willasse 1987) and are active at a temperature of -16°C. Larvae of *Sergentia* live at over 1000 meters depth in the abyss of Lake Baikal (Linevich 1963). The family Chironomidae is a cosmopolitan group of dipteran insects representatives of which occur in all zoogeographic regions of the world (Ashe *et al* 1987). The seven zoogeographical regions *viz.*: Antarctica, Australoasian, Afrotropical, Nearctic, Neotropical, Oriental and Palearctic includes ten subfamilies of Chironomidae *viz.* Aphroteniinae, Buchonomyiinae, Cheilenomyiinae, Chironominae, Diamesinae, Orthocladiinae, Podonominae, Prodiamesinae, Tanypodinae and Telmatogetoninae. Chironomids spend most of their lives as benthic larvae living and feeding on the sediment (Oliver 1971). Chironomids are closely related to mosquitoes (Culicidae) and biting midges (Ceratopogonidae). Unlike Culicidae and Ceratopogonidae, female Chironomids do not bite due to the absence of elongated mouthpart and they lack wing scales too. The larvae of most Chironomids hatch out from the eggs and usually lead bottom dwelling life forming tubes with the help of silk secreted from the salivary glands taking and taking of clay particles and organic matters from the substratum. Some forms are found to live inside muddy substratum. Chironomids are an important food source for large predatory invertebrates, fishes, and birds (Hudson *et al* 1990). Chironomids are important contributors of carbon and energy flow to higher trophic levels (Benson *et al*, 1980). Chironomids have an important role in aquatic food webs, representing a major link between producers, such as phytoplankton and benthic algae and secondary consumers (Tokeshi 1991).

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Materials and methods:-

Larval Chironomids were collected from four geographic sampling sites in Udaipur *viz*. - Fatehsagar Lake, Pichola Lake, Udaisagar Lake and Ayad River. Random samplings were done on each of the four sampling sites. They were collected by sieving substrate with 0.5 mm sieve near the shore and evaluated for their density. Then collected larvae were carried to the laboratory in plastic bottles. Then larvae were examined under a compound microscope for identification up to genera using keys (Epler, 2001). Altitudes, Longitudes and Latitudes for each sampling site were recorded with the aid of Spice android one Smartphone GPS. Randomly collected 100 larvae in each sampling were used for diversity analysis. Shannon- Wiener diversity index ($H= - \sum Pi\ In\ Pi$), Simpson index (1-D), Dominance (D) and evenness (E) was applied for calculating diversity. Data analysis and statistics was done using *Past* software.

Results and Discussion:-

Present study was conducted at four sampling sites *viz.* Fatehsagar Lake, Pichola Lake, Udaisagar Lake and Ayad River. These sites represents Udaipur region well because of their geographic location all around Udaipur and covers both lentic (Lakes) and lotic (River) habitats (Table 1).

Table 1:- Geography of sampling sites.

Location	Latitude (N)	Longitude (E)	Altitude (m. a. s. l.)	Habitat
Fatehsagar	24.608225	73.677421	567	Lentic
Pichola	24.563055	73.682431	569	Lentic
Udaisagar	24.577515	73.825043	546	Lentic
Ayad	24.582585	73.724183	558	Lotic

Chironomid larvae were distinguished from other Dipteran larvae by following features.
1. Spiracles absent (apneustic)
2. Prolegs on first thoracic and terminal abdominal segments.
3. Terminal abdominal segment with paired procerci, each bearing a tuft of setae.

Subfamily Chironominae was distinguished from other subfamilies of Chironomidae with following larval characters.
1. Ligula absent.
2. Mentum present.
3. Two eye spots present.
4. Striated ventro-mental plate present.
5. Non-retractile antennae present.

Tribe Chironomini was distinguished with following larval characters.
1. Antenna has 5 segments.
2. Mentum has 12 lateral teeth.

Three genera identified in this study, possess following distinguished larval characters (Table 2)-

Table 2:- Distinguished larval characters of three identified genera.

Characters	*Einfeldia* Kieffer	*Polypedilum* Kieffer	*Chironomus* Meigen
color	Red	Red	Red
Size	Medium sized	Smaller	Large sized
Mentum	Simple median tooth	Dark, 4 median teeth	Trifid median tooth
Mandibles	Light, 2 inner teeth	Dark, 3 inner teeth	Light, 3 inner teeth
Ventral tubules	One pair, Short, uncoiled	Absent	Two pairs, long, coiled

Chironomidae family has been divided into 11 subfamilies (Chironominae, Orthocladiinae, Prodiamesinae, Diamesinae, Buchonomyiinae, Chilenomyiinae, Tanypodinae, Usumbaromyiinae, Podonominae, Aphroteniinae and Telmatogetoninae. Chaudhuri *et al* (2001) prepared a checklist of Chironomid midges of the Indian subcontinent. It includes 313 species under 60 genera under four subfamilies. Four subfamilies are Diamesinae, Tanypodinae,

Orthocladiinae and Chironominae, there are no Chironomid species reported from Rajasthan. However, *Chironomus circumdatus* was identified later in Jaipur (Sharma & Gupta 2014) which is 340 km far from Udaipur. Three genera reported in present study belong to single subfamily Chironominae.

Table 3:- Diversity status of Chironomids in four sampling sites.

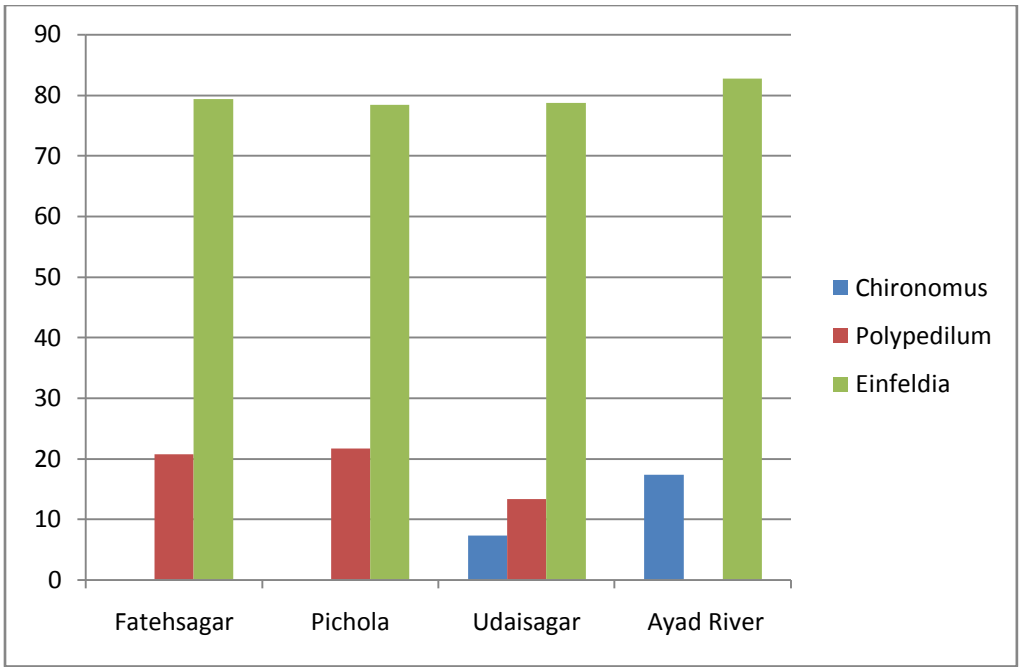
Taxa	Fatehsagar	Pichola	Udaisagar	Ayad
Chironomus	Not found	Not found	7.33%	17.33%
Polypedilum	20.66%	21.66%	13.33%	Not found
Einfeldia	79.33%	78.33%	78.66%	82.66%

Chironomus was found to be absent in Fatehsagar and Pichola Lake. This may be due to their non resilience. *Polypedilum* and *Einfeldia* were found to be in equal percentage in Fatehsagar and Pichola, this may be due to their common drainage system. *Polypedilum* was found to be absent in Ayad due to their lentic habitat preference and Udaisagar have all three subfamilies, may be due to isolated habitat getting drainage from both Ayad River and other sources in rainy season. However we have to keep in mind that Chironomids can disperse not only in larval forms but also in their adult forms through flying. So there is free interbreeding may present in all sampling sites because Fatehsagar and Pichola Lakes are adjacent and Ayad River connects both lakes to Udaisagar Lake. Complete dominance of Chironominae in all four sampling sites is related to their adaptability and survival in low oxygen environments due to presence of hemoglobin analog in their bodies.

Biodiversity analysis of Chironomids up to generic level showed that Chironomids are most diverse at Udaisagar Lake. This may be due to water quality remain constant in this water bodies and water is available all year. Udaisagar provides dominant site for Chironomids because only hardy Chironomid species can survive off rainy season. Water level of Udaisagar gradually falls in off rainy season. We know that Chironomids live near shore in benthic habitat and eat soft detritus. So only highly adaptable can survive and became dominant. The decrease in diversity in Ayad River is related to organic and industrial pollution. It might also note that River is completely dry sometimes in the year. This may be another reason for less diversity. This study also refutes the myth that every red colored larvae collected for study of polytene chromosome, in this area is *Chironomus.*

Table 4:- Diversity indices of Chironomid taxa in four sampling sites.

	Fatehsagar	Pichola	Udaisagar	Ayad
Taxa	2	2	3	2
Dominance (D)	0.6721	0.6606	0.6507	0.7134
Simpson (1-D)	0.3279	0.3394	0.3493	0.2866
Shannon (H)	0.5094	0.5226	0.6466	0.4611
Evenness (E)	0.8322	0.8432	0.6363	0.7929



Graph 1:- Relative abundance of Chironomid genera in four sampling sites.

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