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Diversity and Distribution of Trichoptera in Three Streams of Eastern Ghats, India

T. Sivaruban, S. Barathy¹ and Pandiarajan Srinivasan

Department of Zoology, The American College, Madurai-625 002, India

¹Department of Zoology, Fatima College, Madurai-625 018, India

E-mail: sivaruban270@gmail.com

Abstract: The present work was carried out from October 2017 - February 2018 to contemplate the diversity and distribution of caddis fly larvae in Manikyan kada, Ayyanar, and Siruaruvi streams of Eastern Ghats. Canonical correspondence analysis was used to find the relationship between ecological attributes and caddis fly larvae. A total of 749 individuals belonging to fourteen genera and eight families were collected during the study. Hydropsychidae was found to be the more dominant taxa in all three streams. The diversity indices values show that Siruaruvi falls was the most diverse among the three streams. Temperature, pH, rainfall, and DO become the most important element in governing the diversity and distribution of trichopterans in the three streams. CCA results reveal that taxa *Cheumatopsyche* sp becomes the most dominant taxa due to their high degree of survival to a wide range of water quality parameters.

Keywords: *Cheumatopsyche*, Hydropsychidae, Temperature, pH

Trichopterans are also known as caddis flies, larvae of caddis flies are aquatic and they mostly reside in the freshwater habitat. It serves as potential bio indicators of good water quality and they are sensitive to anthropogenic impacts (Chang et al 2014). Currently, there are about 16,000 species described which makes them as seventh abundant insect order in the world and the second most abundant aquatic insects. Other than bio monitoring activity, they do certain important roles in food webs of the freshwater ecosystem, climatic changes effects in the lotic environment and also helpful in forensic investigations by their scavenging activity and cases build by them. Trichopterans in conjunction with other aquatic insect orders like Ephemeroptera and Plecoptera serve as excellent bio indicators to assess aquatic biodiversity and stream health (Anbalagan and Dinakaran 2006).

Indian trichopterans comprise about 28 families, compare to North India, Southern parts of India were exposed less in the light of the taxonomy of trichopterans. The larval taxonomy is poorly studied in trichopterans due to a lack of knowledge and the difficulty in associating larvae with adults. Only a few works have been done in the taxonomy and ecology of Trichoptera in the Eastern and the Western Ghats of Southern India such as the spatiotemporal distribution of larvae in the Western Ghats of peninsular India (Dinakaran and Anbalagan 2010), description of new species of *Lepidostoma* from Alagar hills (Dinakaran et al 2013) and little reports from southern Eastern Ghats (Dinakaran and

Anbalagan 2010, Srinivasan et al 2019). Canonical correspondence analysis (CCA) was used to find the relationship between environmental attributes and the trichopteran population (Dinakaran and Anbalagan 2010). So this investigation means to contemplate the diversity and distribution of caddis fly larvae and CCA was used to find the relationship between ecological attributes and caddis fly larvae.

MATERIAL AND METHODS

Study area: The selected areas of study were Karanthamalai manikyan kada waterfalls, Iyyanar falls, Siruaruvi on the Eastern Ghats of Tamil Nadu from October 2017 to February 2018. The latitude and longitude of the three streams were 10°32' N 78°23' E, 10°32' N, 78°19' E, and 10°10' N, 78°21' E, respectively.

Sampling: Physico-chemical parameters of stream water were analyzed following APHA (2005). In riffle samples, caddis flies larvae were collected utilizing 180-µm-mesh kick-nets, 500-µm-mesh dip nets were utilized for pool inspecting, and handpicking was also made. All caddis fly larvae were distinguished to the least conceivable taxonomic level using available keys (Wiggins et al 1994, Dudgeon 1999). The collected larvae were preserved in 80 % alcohol.

Data analysis: The statistical analysis such as Shannon and Simpson indices and CCA were done with the help of PAST 4.02 software packages (Hammer et al 2001).

RESULTS AND DISCUSSION

Sampling trichopteran immature from October 2017 - February 2018 resulted in a total of 749 individuals belonging to fourteen genera and eight families from Manikyan kada, Ayyanar, and Siruaruvi streams (Table 1). In the three streams, Siruaruvi has more diverse taxa in all three months of sampling whereas Manikyan kada supports less diverse taxa in February 2018 consists of only eight genera. Among the eight families, Leptoceridae and Hydropsychidae were the most diverse families, which holds four and three genera respectively in Siruaruvi falls, whereas Hydropsychidae was the most diverse family in Manikyan kada and Ayyanar falls. Hydropsychidae was the more dominant taxa in all three streams consisting of 126 individuals in Siruaruvi falls, 99 individuals in Manikyan kada stream, and 73 individuals in Ayyanar falls. The same trend was observed by Henriques-Oliveira et al (2015), indicating, Hydropsychidae is the most dominant taxa.

Shannon and Simpson's indices indicate the total amount of diversity that exists in the ecosystem. Shannon index was highest in October 2017 of Siruaruvi falls indicating the presence of higher diversity of trichopterans in the

ecosystem and lowest in February 2018 of Manikyan kada stream. The same trend was seen in Simpson's index also as the value tends to be highest in October 2017 of Siruaruvi falls and it is lowest in February 2018 of Manikyan kada stream (Table 2). On the whole, these diversity indices show that Siruaruvi falls were the most diverse among the three streams and it supports 13 genera of trichopterans in all three months, whereas the other two streams show little changes in diversity in various months. The reason for the loss of abundance of trichopterans in all the three streams in February is due to fact that it was a post-monsoon period that lacks rainfall and trichopterans show a high level of positivity towards low rainfall period compared to high rainfall and dry seasons (Kim et al 2018). The present study also substantiates with that, as the taxa tend to increase in the low rainfall month of December whereas low diversity was seen in the high rainfall (October) and dry period (February).

Water quality parameters form a most important element in controlling the population dynamics of all the aquatic insects and results also substantiate that as trichopterans show variation in diversity and distribution with water quality parameters (Table 3). The pH of running waters ranges from

Table 1. Number of trichoptera larvae collected from three streams of Eastern Ghats

Family	Genus and species	Manikyan kada			Ayyanar falls			Siruaruvi		
		October	December	February	October	December	February	October	December	February
Rhyacophilidae	<i>Rhyacophila</i> sp	10	12	4	12	11	11	13	17	11
Philopotamidae	<i>Wormaldia</i> sp	7	7	2	6	7	2	5	9	3
	<i>Chimarra</i> sp	4	9	0	1	3	0	4	3	1
Polycentropodidae	<i>Polycentropus</i> sp	8	12	3	12	16	6	9	14	5
Hydropsychidae	<i>Hydropsyche</i> sp	12	22	10	8	14	10	18	19	9
	<i>Cheumatopsyche</i> sp	14	25	12	13	15	7	19	29	17
	<i>Macrostemum</i> sp	0	4	0	0	5	1	5	8	2
Lepidostomatidae	<i>Lepidostoma</i> sp	7	7	3	5	9	2	6	9	6
Leptoceridae	<i>Adicella</i> sp	0	2	0	0	3	0	4	5	2
	<i>Leptocerus</i> sp	4	4	0	4	7	4	5	9	7
	<i>Oecetis</i> sp	0	0	0	0	0	0	1	3	1
	<i>Setodes</i> sp	0	0	0	0	0	0	2	5	1
Glossosomatidae	<i>Agapetus</i> sp	8	12	2	1	0	2	0	0	0
Stenopsychidae	<i>Stenopsyche kodaikanalensis</i>	5	8	1	0	0	0	8	13	5
	No of individuals	79	124	37	62	90	45	99	143	70
	No of taxa	10	12	8	9	10	9	13	13	13

Table 2. Diversity Indices of three streams of Eastern Ghats

Diversity indices	Manikyan kada			Ayyanar falls			Siruaruvi		
	October	December	February	October	December	February	October	December	February
Shannon Index (H)	2.22	2.28	1.78	1.96	2.16	1.95	2.32	2.37	2.23
Simpson Index (1-D)	0.88	0.88	0.79	0.84	0.87	0.83	0.88	0.89	0.86

6.5 to 7.5 and falls within the limit except in the February of Manikyan kada stream and Ayyanar falls. The reason for this is because of detergents and soap use by the tribal peoples to bath and washes the clothes. In the monsoon period, due to high water flow, this polluted water runs off easily and it does not affect that much and during the post-monsoon period, due to decreased rainfall the polluted water settled in the ecosystem due to less water flow, as a result of that every parameter of water quality affected and this, directly and indirectly, affects the diversity of trichopterans and other pollution sensitive taxa in the freshwater habitat. A similar trend was seen in the air and water temperature, as the temperature tends to increase in the February of all the three streams, and this high temperature subsequently affects

dissolved oxygen levels, and this depletion in DO can cause major shifts in the population dynamics of trichopterans. Dissolved oxygen levels below 3 mg/l are stressful to most aquatic organisms. The present study results show that DO values were above the permissible value except in February in all three streams. The other water quality parameter falls within the permissible limit. The results show that temperature, pH, rainfall, and DO become the most important element in governing the diversity and distribution of trichopterans in the three streams.

CCA was performed to compare the Trichoptera community with each of the 11 environmental variables (Fig. 1). CCA ordination diagram, shows that axis 1 accounts for 63%, and axis 2 for 36%, and the results show that taxa

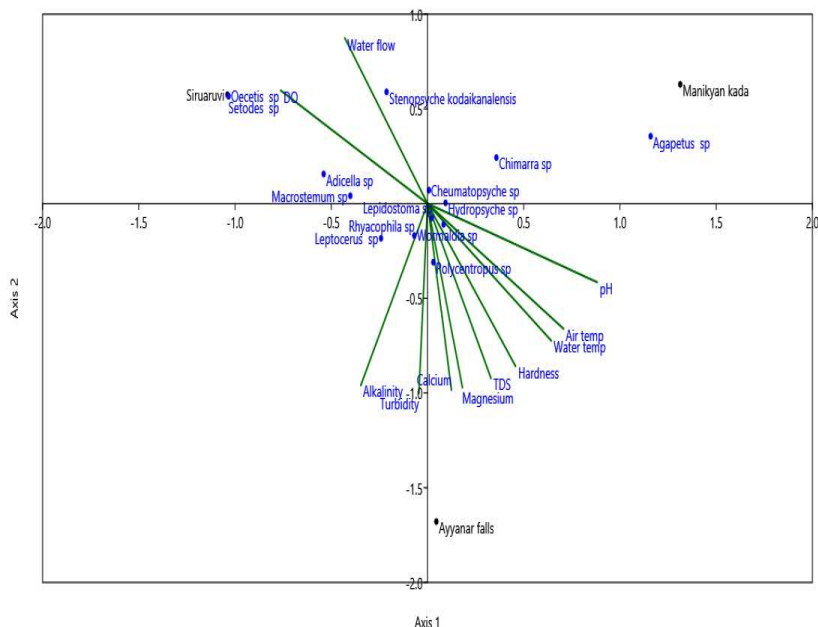


Fig. 1. CCA plot of trichoptera and ecological attributes in three streams of Eastern Ghats

Table 3. Physico-chemical parameters of three streams of Eastern Ghats

Physico-chemical parameters	Manikyan kada			Ayyanar falls			Siruaruvi		
	October	December	February	October	December	February	October	December	February
Water temperature (°C)	21.2	20.3	23.5	21.4	20.5	23.9	20.9	19.9	22.4
Air temperature (°C)	28	27.2	30.6	28	27.4	30.9	27.3	26.7	30.1
pH	7.3	7.5	7.8	7.4	7.3	7.8	7.2	7	7.2
DO (mg l ⁻¹)	3.33	5.13	2.6	3.53	5.02	2.2	4.53	5.43	2.9
Alkalinity (mg l ⁻¹)	15.42	14.95	14.23	16.12	15.16	15.73	15.12	14.85	15.38
Calcium (mg l ⁻¹)	5.16	4.8	5.23	5.38	4.92	5.53	5.03	4.79	5.23
Magnesium (mg l ⁻¹)	3.24	2.64	3.5	3.47	2.89	3.67	3.04	2.54	3.60
Water flow (m s ⁻¹)	0.38	0.67	0.23	0.29	0.53	0.20	0.43	0.72	0.36
TDS (ppt)	0.17	0.16	0.21	0.19	0.17	0.23	0.17	0.15	0.19
Turbidity (NTU)	0.04	0.03	0.04	0.05	0.03	0.06	0.04	0.03	0.04

Cheumatopsyche sp. has a positive correlation with high levels of almost all water parameters and this leads to the fact that it becomes the most dominant taxa due to their high degree of survival to a wide range of water quality parameters. The taxa such as *Hydropsyche* sp, *Lepidostoma* sp, *Wormaldia* sp, and *Polycentropus* sp shows positivity to temperature, pH, hardness, total dissolved solids, calcium, and magnesium and shows negativity towards high levels of dissolved oxygen and water flow and it reveals that they forms the most tolerant taxa next to *Cheumatopsyche* sp. Other taxa like *Macrostemum* sp, *Oecetis* sp, *Setodes* sp, *Adicella* sp, and *Stenopsyche kodaikanalensis* which show different community structure in contrast with *Hydropsyche* sp as these taxa prefer low levels of temperature, pH, hardness, total dissolved solids, calcium and magnesium and high levels of dissolved oxygen and water flow. *Leptocerus* sp and *Rhyacophila* sp prefer high levels of alkalinity and turbidity whereas *Chimarra* sp and *Agapetus* sp prefer low levels of alkalinity and turbidity. This result supports the findings of Bonada et al (2004) as Hydropsychidae were a very tolerant family which tolerates a wide range of water quality parameters.

CONCLUSIONS

The present study gives more knowledge in the diversity and distribution of trichopteran larvae. Ecological attributes like temperature, pH, DO and rainfall become the most important element in governing the diversity and survival of trichopterans in the three streams, and taxa tend to increase in the low rainfall in December whereas low diversity was seen in the high rainfall (October) and dry period (February). CCA results reveal that *Cheumatopsyche* sp becomes the most dominant taxa due to their high degree of survival to a wide range of water quality parameters. This study suggests more researches to be carried out to find the exact status of the ecology and community structure of trichopterans and their bio monitoring potential in the Western and the Eastern Ghats of India.

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