J. Mountain Res. P- ISSN: 0974-3030 DOI: https://doi.org/10.51220/jmr.v14i2.7
Vol. 14 (2), (2019), 63-67

A REPORT ON DRIFTING BEHAVIOUR OF ODONATA (AQUATIC INSECTS) IN KYUNJA GAD, A SPRING FED TRIBUTARY OF RIVER MANDAKINI, CHAMOLI GARHWAL, UTTARAKHAND

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Received: 12.10.2019; Revised: 17.11.2019; Accepted: 12.12.2019

Abstract: Odonata is an important group of macroinvertebrates which are highly sensitive to environmental changes and pollution. This is the reason why they are mostly studied as change in water quality pattern. The dial study of drifting behavior in such species also indicates towards the feeding behavior of fishes available in that habitat. In the present communication an attempt has been made to view the drifting patterns in a sensitive macro zoobenthic group Odonata in the Kyunja Gad which is a tributary of the snow-fed River Mandakani.

Keywords: Odonata, Drifting, Kyunja gad, Mandakini, Rudraprayag

Introduction

Benthic invertebrates are the important components of the food web in aquatic ecosystems. These insects are an important food of fishes, hence are important component of the aquatic food chain. Odonata larvae depend on the quality of the aquatic habitat, and hence they are sensitive to changes in the environmental settings. Therefore, they have been widely used as bioindicators for environmental health and integrity. In aquatic environments, habitat integrity is an important factor structuring the aquatic communities of insects including Odonata (Souza et al., 2015; Martin and Maynou, 2016). The stream macrozoobenthos have been studied by various workers under specific fields like: ecology and distribution (Zettler and Darius, 2007), substratum relationships (Hynes, 1974; Tuvikene *et. al.*, 2004), Diel migration and drift (Rader and Ward, 1990; Dudgeon, 1990) etc.

Studies on the hill stream macrozoobenthos of Garhwal Himalayan region are made by Dobriyal and Singh (1988), Dobriyal *et. al.*, (1992), Balodi and Koshal, (2015), Koshal *et. al.* (2017), and Bahuguna and Negi (2018). The drifting macrozoobenthos are studied by various researchers under specific fields like drifting patterns and colonization (Smock, 1996), drift dynamics and Seasonal fluctuations (Dudgeon, 1990,) drifting benthos as indicators of water quality (Kremen, 1992) and drifting of macroinvertebrates in Garhwal Himalaya (Kumar *et al.*, 2006). The present studies was undertaken with the objective to analyse the macrozoobenthos drifting behaviour of Odonata and riparian vegetation in the Kyunja Gad 1st order spring-fed hill stream of the river Mandakani.

Materials and Methods

Study Area

The Kyunja Gad spring-fed hill stream has been selected as the study area. The Kyunja Gad is a tributary of the snow-fed River Mandakani. It is situated in the Latitude 30º25′45″N and Longitude 79º 08′ 35″ E and receives water from numerous springs, underground seepage and surface runoff. This stream is mainly a *Quercus*-forest based stream. The stream Kyunja Gad (1st order stream) was studied near Senagarsari village at the spot 1 towards the head waters and spot 2 near the Jaykandi (downwards) (Map 1). The first order stream of Kyunja Gad has a stretch of nearly 3.9 Kilometers.

Map 1. Sampling site of 1st order stream Kyunja Gad.

Drifting Sampling

The Sampling followed the protocol presented by Smock (1996). The drifting Samplers used were essentially the same as those described by Field-Dodgson (1985) having an internal diameter of 16.6 cm, a length of 1.7 m and 220 micron mesh size has been used. As far as possible replicate samples as suggested by Canton and Chadwick (1988) were taken for riffle and runs for increased precision in estimates of total density and species diversity. The drifting benthos were preserved in 70% ethyl alcohol and brought to the laboratory for enumeration and identification using Ward and Whipple, 1966; Needham and Needham, 1962; Tomka and Zurwerra, 1985 etc. The identification was done to the lowest possible practical taxon.

Results and Discussion

Four genera of macro-invertebrates were identified in collections of drift macrozoobenthos from the site on the Kyunja Gad stream. The number of the order Odonata, At the 1st order stream a maximum of 4, 6, 5 individuals m^{-3} and macrozoobenthos were recorded in drift during December, February and April and minimum of 1 individuals m^{-3} in November, March and May month in 2017 to 2018 respectively.

The *Argia sp.* was single specimen present in December, April, September and was observed to be absent during rest of the months at the 1st order Kyunja Gad stream. The maximum of *Zygonyx sp.* was observed to be present in the months of February.

The drifting density of *Euphaea* sp. was very low being 1 individual's m^{-3} in November, February, April, September and high 3 individual in the month of March. Genus *Gompidictus* single species was observed in December, April and June in the 1st order stream Kyunja Gad during 2017-2018 respectively. These lacks of similarity in drift composition no doubt reflect seasonally different sampling times and the variety of stream types so far sampled. Periodicity in benthic invertebrate drift is a well-known phenomenon reported in a wide variety of lotic system throughout the world (Water, 1972). In this study, drifting behaviour was strongly nocturnal in the presence of diurnally feeding fish. At these locations, predator communities were dominated by diurnally active fish and nocturnally active carnivorous *Noemacheilus* sp.

Table 1: Monthly wise variations in the drifting behaviour of Order -Odonata of the stream Kyunja Gad during the year 2017-18.

1	**Odonata**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
a	*Argia*	0	0	1	0	0	0	1	0	0	0	0	1
b	*Zygonyx*	1	0	0	2	3	1	2	1	1	0	0	1
c	*Euphaea*	2	1	2	0	1	3	1	0	0	0	0	1
d	*Gompidictus*	0	0	1	0	2	0	1	0	1	0	0	0
	Total	3	1	4	2	6	1	5	1	2	0	0	3

Flecker (1992) observed that drift periodicity differed among sites that varied in fish faunal composition. Although differences between fish assemblages are in part confounded by elevation, variation in diel periodicity among sites is not easily explained by other changes such as changes in physical factors associated with an altitudinal gradient.

Hieber *et. al.*, (2003) reported that the drifting invertebrates showed no consistent diel periodicity in different alpine streams. In a fishless alpine Kryal stream, however, Robinson *et. al.*, (2002) found distinct diel patterns in which drift density was maximum during day, being associated with the summer afternoon peak in discharge. Discharge during the study period of different alpine sites, however, was relatively constant within a season, showing no significant diel differences and thus, had no influence on diel drift patterns. The nocturnal drift patterns are commonly believed to be an evolutionary response to reduce the risk of predation by visual fish predators (Allan, 1978). Hayes *et. al.*, (2000) opined that reliable quantification of drift is necessary for investigating some aspects of trophic interaction between invertebrates and drift-feeding fish.

Acknowledgement

First author (P.B.) gratefully acknowledge the financial assistance rendered by Science and Engineering Research Board (SERB) under a major Project No. ECR/2016/001291.

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