Abstract

Largest **glacier-fed** river Teesta and its **spring-fed** tributary hill-stream Relli in the Darjeeling Himalaya were studied from March 2007 to February 2009 for assessing some selected physico-chemical parameters of water quality, density and diversity of phytoplankton, zooplankton and ichthyofauna through space and time. The present study evaluated the hypothesis that the tropical seasonality of this sub-tropical region affects the physico-chemical water quality of glacier-fed river and spring-fed hill-stream in different styles. This as a far-reaching consequence alters the density and diversity of phytoplankton, zooplankton and ichthyofauna in a predictable manner. The objective of the study was to compare diversity of plankton and ichthyofauna and their relationship with water quality in the glacier-fed river Teesta and its spring-fed tributary hill-stream Relli. The mean values of water temperature, pH, specific conductance, dissolved oxygen, free carbon dioxide and chloride in Teesta river water were found lower than those of the hill-stream Relli. But, the mean values of water velocity, total alkalinity, total hardness, NH₄-N, NO₂-N, NO₃-N and PO₄-P were found higher in Teesta river than those of the Relli. Water Quality parameters of both the streams showed strong seasonal dynamics, significant correlation and altitudinal variations, all pointing towards a unique pattern. Principal Component Analysis (PCA) reduced all the physico-chemical variables to two sets of uncorrelated transformed variables in the river Teesta (PC-I and PC-II) and three variables in the stream Relli (PC-I, PC-II and PC-III).

A total of 47 genera of phytoplankton found in the river Teesta was higher than 34 genera observed in Relli. Both the streams were dominated by Bacillariophyceae followed by Chlorophyceae, Cyanophyceae and Euglenophyceae. Value of similarity Index of phytoplankton between two streams was 0.84. The average values of density, number of genera, Shannon-Wiener Diversity Index and Margalef’s Richness Index of phytoplankton in the Teesta were higher than those of Relli. On the contrary, mean value of Evenness Index in Teesta was slightly lower than that of Relli. Interestingly, same mean value of Index of Dominance of phytoplankton were observed in both the streams.

A total of 22 genera of zooplankton found in Teesta were higher than 18 genera observed in Relli. The river Teesta was dominated by Rotifera followed by Cladocera, Protozoa, and Copepoda. But in Relli zooplankton community was dominated by Rotifera followed by Protozoa, Copepoda and Cladocera. Value of similarity Index of zooplankton
between two streams was 0.80. Average values of density, number of genera, Shannon-Wiener diversity index, Evenness Index and Margalef’s richness index in Teesta were higher than those of Relli. On the contrary, mean value of Dominance Index of zooplankton in Teesta was lower than that of Relli.

A total of 65 species of fish belonging to 3 orders, 10 families and 39 genera found in Teesta were higher than 25 species of fish belonging to 5 families and 15 genera observed in Relli. Maximum number of rheophilic, cold water hill stream species belong to the order Cypriniformes followed by Siluriformes in both the streams. Value of Similarity Index of ichthyofauna between two streams was 0.56. Among these fishes 10 species are endemic to India and about 55% fish species are threatened. Mean values of Fish Catch Per Unit Effort (CPUE), estimated population size, Number of Fish Species, Shannon-Wiener Species Diversity Index and Margalef’s Species Richness Index in Teesta were higher than that of the Relli. On the contrary, mean values of Evenness Index and Dominance Index of ichthyofauna in Teesta were lower than those of Relli.

Abundance and diversity indices of phytoplankton, zooplankton and ichthyofaunal community in both the streams showed strong seasonal dynamics, strong altitudinal variations, weak annual dynamics and significant correlation amongst themselves and with water quality parameters, all pointing towards a unique pattern. Regression analysis showed causal relationship between the principal components of physico-chemical parameters and density and diversity indices of phytoplankton, zooplankton and ichthyofaunal community. Seasonality driven physical factors such as water velocity and water temperature were responsible for more mineralization of stream water by dissolving inorganic ions and nutrients which in turn regulating dynamics of density and diversity of plankton and ichthyofauna in a predictable fashion year after year until a big natural calamity. The study provides baseline data which may be helpful for conservation and management of the streams, biodiversity and also formulating new fishery policy.

**Key words:** Darjeeling Himalaya, Ichthyodiversity, Teesta River, Hill-Stream Relli, Physico-Chemical Parameters, Zooplankton, Phytoplankton, Population Density, Catch Per Unit Effort, Population Size, Diversity Indices, Pearson’s Correlation, PCA, Regression analysis.