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Seasonal Variation and Distribution Pattern of Copepod Diversity in Pravara River Dist. Ahilyanagar (MS) India

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ABSTRACT

This study investigates the seasonal variation and distribution pattern of copepod diversity in the Pravara River, Maharashtra, India, from June 2023 to May 2024. Seven sampling sites representing varied ecological zones were examined monthly. A total of 842 copepod individuals belonging to eight species were identified. The highest abundance was recorded during winter 42.99 % (362individuals) and summer 42.40 % (357 individuals), with the lowest during the monsoon season 14.61% (123 individuals). *M. aspericornis* was the dominant species, followed by *M. edax* and *M. leuckarti*. Diversity indices revealed a highly balanced community (Simpson's 0.87; Shannon 1.98; Evenness 0.95). These findings suggest that copepod populations in the Pravara River are strongly influenced by seasonal hydrological fluctuations, with post-monsoon stability favouring higher species richness and abundance. The study underscores the potential of copepods as effective bioindicators for assessing freshwater ecosystem health and productivity

Figures : 04 References : 30 Tables : 05

KEY WORDS : Copepods, Distribution, Diversity, Pravara River, Seasonal Variation.

Introduction

Copepods are vital components of freshwater ecosystems, serving as primary consumers and mediators in nutrient cycling and energy flow[13]. Copepods are small crustaceans belonging to the subclass Copepoda, typically ranging from 1.2 mm to a few millimetres in size. They are among the most abundant zooplankton in aquatic environments and play a crucial role in transferring energy from phytoplankton to higher trophic levels such as fish and other aquatic organisms[4]. Copepod diversity is increasing rapidly due to favorable environmental conditions, availability of food resources, and suitable water quality.Their presence and abundance often serve as indicators of water quality and ecosystem health.

Copepods are the most diverse groups of zooplankton in aquatic ecosystems. Globally, more than 14,000 species of copepods have been reported from marine, freshwater, and brackish water habitats, while about 500–550 species have been recorded from various aquatic ecosystems in India[3,23]. Their body is elongated and segmented, typically divided into cephalosome,

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TABLE-1: Sampling Sites location and GPS coordinates

Sampling site code	Site names	Coordinates of sampling sites	
S-1	Wilson dam	19°32’13"N	73°45’46"E
S-2	Nilwande Dam	19°32’51"N	73°54’00"E
S-3	Akole	19°32’39"N	74°01’00"E
S-4	Sangamner	19°33’20"N	74°11’45"E
S-5	Ashvi	19°31’16"N	74°21’58"E
S-6	Kolhar	19°32’05"N	74°31’47"E
S-7	Lakh	19°30’18"N	74°41’28"E

metasome, and urosome, and they possess long antennae used for swimming. Most copepods are microscopic and feed on phytoplankton and organic particles. Females usually carry paired egg sacs, and their life cycle includes egg, nauplius, copepodid, and adult stages. They play an important role in aquatic food chains as primary consumers and as food for many fish and aquatic organisms.

The Pravara River offers a unique opportunity to investigate copepod diversity due to its diverse aquatic habitats and fluctuating environmental conditions. The river consists of various ecological zones, including agricultural landscapes, semi-arid regions, and forested areas, each creating distinct microhabitats that influence copepod distribution and community structure[21]. The river’s hydrology is marked by pronounced seasonal changes, including monsoon-driven floods and dry periods, affecting water temperature, flow rates, and nutrient availability, shaping copepod populations[2].

During the monsoon season, increased water flow and nutrient input can enhance copepod diversity and abundance, whereas dry spells may lead to reduced copepod populations and altered community composition[17]. These seasonal variations underscore the adaptability of copepods to changing environmental conditions and their sensitivity to shifts in their habitat[25].

Understanding copepod diversity in the Pravara River is essential for assessing the ecological health of this fresh water system. Documenting species diversity and distribution patterns provides insights into the effects of environmental variability on aquatic communities and supports the development of conservation strategies to preserve freshwater biodiversity[21]. This study seeks to offer a comprehensive analysis of copepod species in the Pravara River, contributing to the broader understanding of fresh water ecosystems and their management.

TABLE-2. Month wise collection from Jun 2023 to May 2024

Sampling Site	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total	%
S-1	9	6	7	3	9	8	5	11	12	18	16	20	124	14.73
S-2	6	4	6	4	5	7	4	12	14	20	17	14	113	13.42
S-3	8	6	4	5	8	9	3	14	19	16	14	10	116	13.78
S-4	5	3	5	7	9	8	6	13	15	14	20	13	118	14.01
S-5	6	4	6	4	11	10	8	11	14	15	17	13	119	14.13
S-6	0	2	3	2	11	11	2	14	21	23	19	17	125	14.85
S-7	2	1	4	1	8	9	6	15	20	22	21	18	127	15.08
Total	36	26	35	26	61	62	34	90	115	128	124	105	842	100.00

TABLE-3 : Seasonal Abundance from Jun 2023 to May 2024

Sampling Site	Summer (Mar-May)	Monsoon (Jun-Sep)	Winter (Oct-Feb)	Total
S-1	54	25	45	124
S-2	51	20	42	113
S-3	40	23	53	116
S-4	47	20	51	118
S-5	45	20	54	119
S-6	59	7	59	125
S-7	61	8	58	127
Total	357	123	362	842

Materials and Methods

Study Area

The study was carried out during June 2023 to May 2024 from different localities. The study was conducted along the Pravara river in Maharashtra, India. There were seven Sampling sites which were selected to include various environmental conditions such as farmland, semi-arid zones, and forested regions.

Sampling Locations and Frequency

Seven sampling sites were chosen based on water depth and flow conditions. That were Wilson Dam, Nilwande Dam, Akole, Sangamner, Ashvi, Kolhar, Lakh. The distance between the two Sampling sites was 15 to 20 km. Sampling was performed monthly from May 2023 to Jun 2024 to analyse the abundance and seasonal variation in Pravara river.

Sampling time

As per the recommended times[19] for zooplankton collection, specifically early morning (around 6:00 AM to 9:00 AM) and late afternoon (around 4:00 PM to 6:00 PM) were informed by diurnal vertical migration patterns and the effects of light on zooplankton behavior. These sampling times help to ensure a representative sample of the zooplankton community by aligning with their natural activity cycles and minimizing the impact of daylight on their distribution.

Collection

Copepod samples were collected using a conical plankton net with a mesh size of 25 µm and a diameter of 30 cm[11]. Before sampling, the zooplankton net was rinsed with river water to remove any residual materials

TABLE-4 : Copepod diversity in different sites from Jun 2023 to May 2024

S. No.	Name	S-1	S-2	S-3	S-4	S-5	S-6	S-7	Total	%
1	*Mesocyclops aspericornis*	24	18	19	22	19	24	16	142	16.86
2	*Mesocyclops pehpeiensis*	18	14	10	13	12	18	8	93	11.04
3	*Mesocyclops hyalinus*	22	12	11	12	17	8	4	86	10.21
4	*Mesocyclops leuckarti*	9	10	14	4	16	14	19	86	10.21
5	*Mesocyclops edax*	13	16	15	19	15	20	11	109	12.94
6	*Thermocyclops oithonoides*	7	19	18	11	11	12	18	96	11.40
7	*Acanthocyclops varicans*	11	14	13	13	15	17	23	106	12.58
8	*Acanthocyclops strenuus*	20	10	16	24	14	12	28	124	14.72
	Total	**124**	**113**	**116**	**118**	**119**	**125**	**127**	**842**	**100**

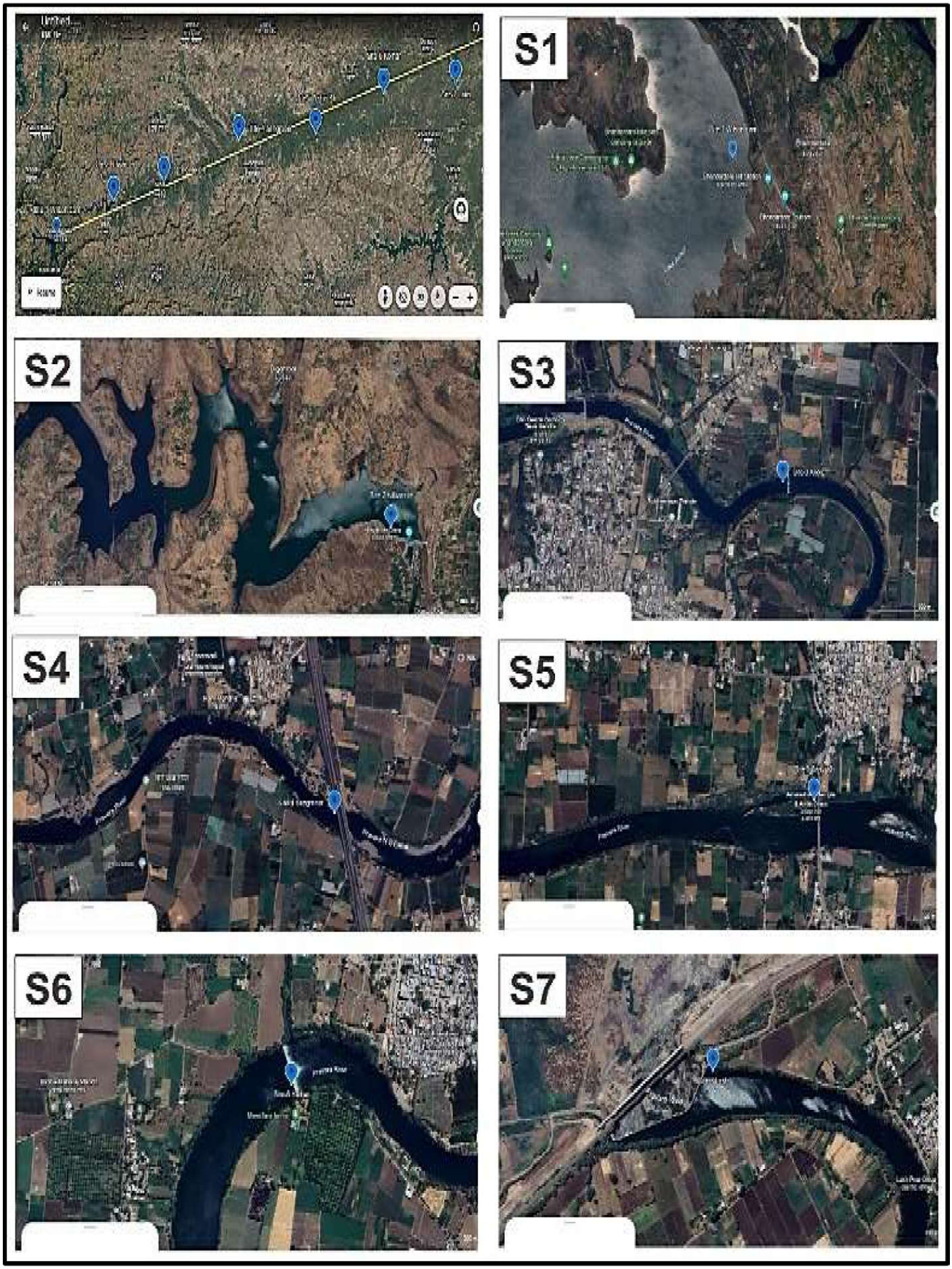

Fig.1 : Sampling sites of the Pravara River Dist. Ahilya nagar (MS) India

and avoid contamination[7]. Approximately 100 liters of river water were filtered through the plankton net and the final concentrate of about 100 ml was collected for further analysis. The collected samples were transferred into 500 ml plastic bottles with tight-fitting caps that were cleaned with distilled water before use[22]. GPS coordinates of each sampling site were recorded for accurate location tracking. The samples were then preserved with 4% formalin and 70% ethanol to prevent decay until laboratory analysis[12]. In the laboratory, copepods were examined, photographed, and counted under a light microscope at 5× to 45× magnification using standard identification guides[20]. Species abundance was calculated as the number of individuals per liter of water and diversity indices such as Shannon, Simpson, and Evenness were used to assess species diversity. Identification of copepod species was carried out using standard taxonomic keys[4,5].

Results and Discussion

During the study period a total of 842 copepod individuals were collected and observed eight species recorded from seven sampling sites during June 2023 to May 2024. Monthly abundance varied markedly, ranging from 26 individuals (July and September) to a peak of 128 individuals in March. The population remained low during the monsoon months (June–September) and increased progressively from October, attaining maximum density during late winter and early summer (January–April). Similar seasonal patterns, with monsoon minimum and winter maximum, have been reported by others[26,28], who attributed reduced abundance during rainy periods to dilution effects and habitat instability. The winter peak observed in the present study is consistent with the earlier findings[18],

TABLE-5 : Diversity index of copepods

Index	Mean Value
Simpson's Index of Diversity (1-D)	0.87
Simpson's Reciprocal Index (1/D)	7.64
Shannon-Wiener Diversity Index (H')	1.98

who noted higher zooplankton density under stable physicochemical conditions and enhanced primary productivity.

Site-wise distribution showed relatively uniform abundance among stations, ranging from 13.42% to 15.08%, with S-7 recording the highest contribution (127 individuals) and S-2 the lowest (113 individuals). Comparable minor spatial variations influenced by nutrient status and local habitat characteristics have been documented[10,30].

Seasonal analysis (Table-3; Fig. 2) showed that copepod abundance was highest during winter(362 individuals) and summer (357 individuals), while the monsoon season recorded significantly lower abundance (123 individuals). The reduced population during monsoon may be attributed to rainfall-induced dilution, increased turbidity, and habitat instability, whereas stable physicochemical conditions, optimal temperature, and enhanced phytoplankton availability during winter and summer likely promoted higher reproduction and survival. Similar seasonal patterns, with monsoon minima and winter maxima, have been reported[26,29],

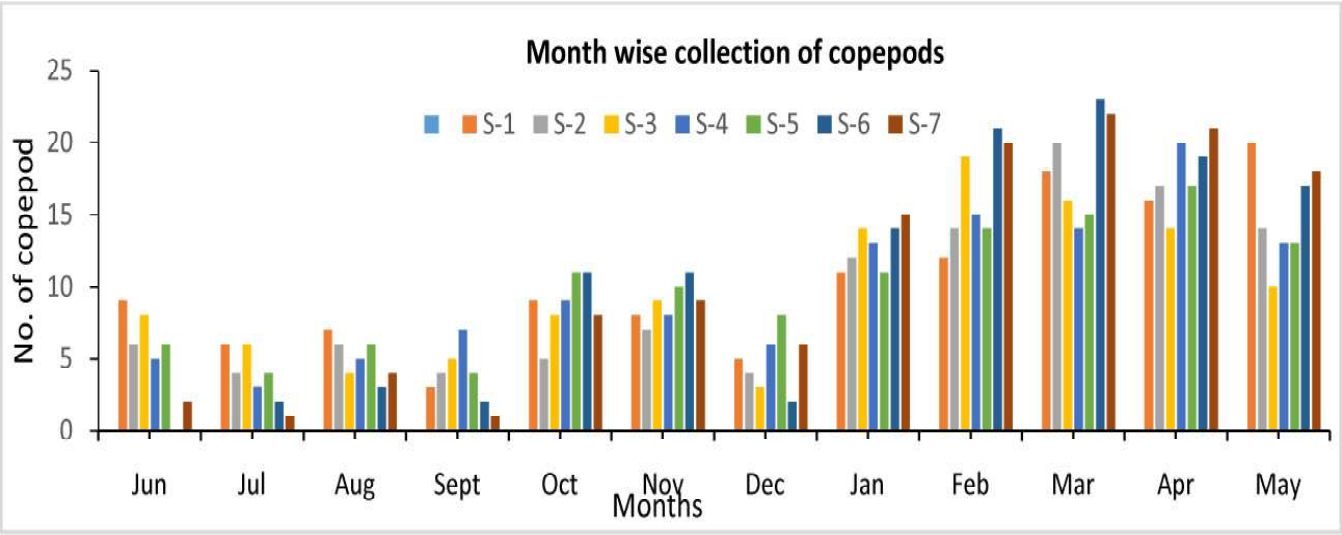

Fig. 2 : Month wise collection from Jun 2023 to May 2024

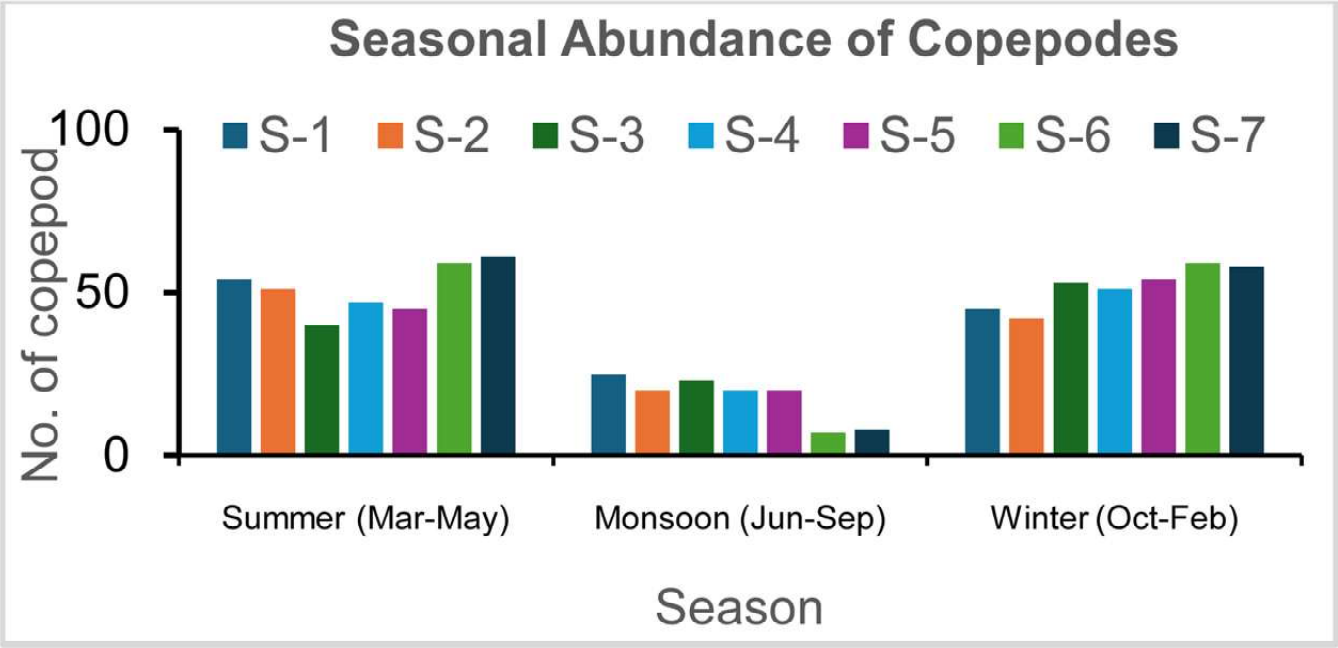

Fig. 3 : Seasonal Abundance of copepods site wise from Jun 2023 to May 2024

indicating that seasonal environmental dynamics play a crucial role in regulating copepod populations in freshwater ecosystems.

There are three genera and eight species of copepods reported from the study area during the period from June 2023 to May 2024 (Table 4; Fig. 3). Among the recorded species, *Mesocyclops aspericornis* 16.86% (142) was the most dominant species, followed by *Acanthocyclops strenuus* 14.72% (124) and *Mesocyclops edax* 12.94% (109). Other species recorded were Acanthocyclops varicans 12.58% (106), *Thermocyclops oithonoides* 11.40% (96), and *Mesocyclops pehpeiensis* 11.04% (93). The least abundant species were *Mesocyclops hyalinus* 10.21% (86) and *Mesocyclops leuckarti* 10.21% (86).

The results show that species of the genus *ss* were more abundant in the study area, indicating their better adaptability to the environmental conditions of the freshwater ecosystem. Similar findings have earlier been reported[26,29], who observed the dominance of cyclopoid copepods, particularly Mesocyclops species, in Indian freshwater bodies. Their higher abundance is mainly due to their ecological adaptability, rapid reproductive cycle, and ability to tolerate environmental variations. Therefore, the present findings are consistent with earlier studies, suggesting that cyclopoid copepods play an important role in freshwater zooplankton communities.

The calculated diversity indices revealed a well-structured copepod community in the study area. Simpson's Index of Diversity (1"D) was 0.87, indicating

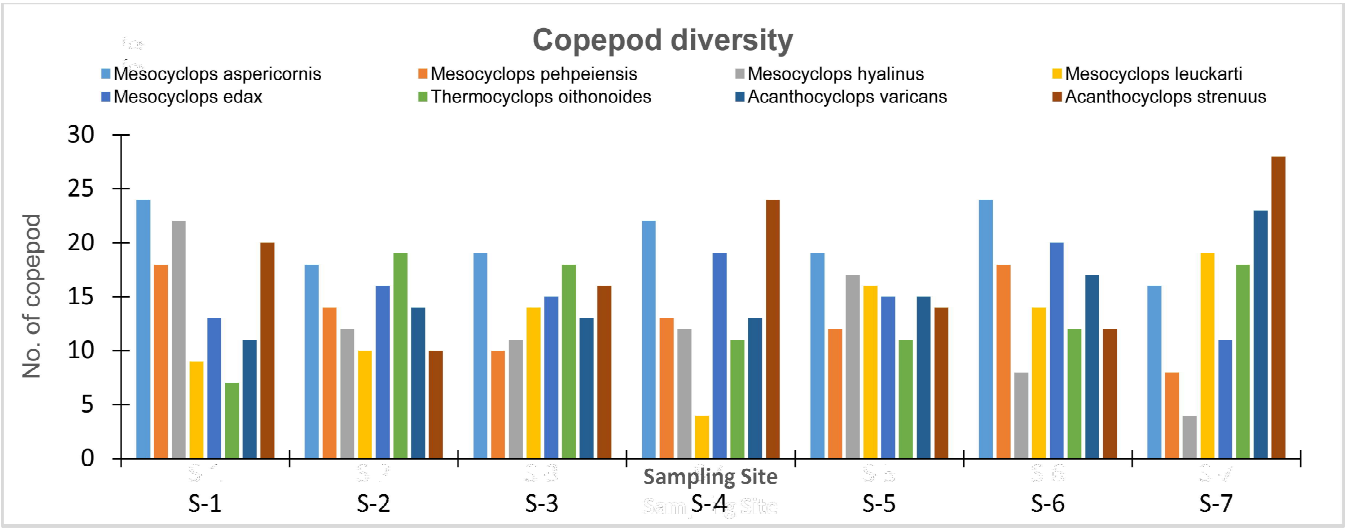

Fig. 4 : Copepod diversity in different sampling sites

a high probability that individuals selected at random belong to different species, while the Simpson's Reciprocal Index (1/D = 7.64) further confirmed substantial species diversity. The Shannon–Wiener diversity index (H2) was 1.98, reflecting moderate to high species diversity. The evenness value (E = 0.95) suggested a nearly uniform distribution of individuals among species. The species richness (S = 8) indicates that eight copepod species were recorded during the study period, collectively demonstrating a diverse and well-balanced community structure.

Conclusion

During the present investigation eight copepod species report with a total of 842 individuals from seven sampling sites during June 2023 to May 2024. The results showed clear seasonal variation, with higher abundance during winter and summer and lower abundance during the monsoon season, indicating the strong influence of rainfall, water stability, temperature, and food availability on copepod populations.

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