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The Crustacean Zooplankton Abundance and Population Density in Bhatye Creek, Ratnagiri, Maharashtra, India

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Abstract: ***The crustacean zooplankton abundance and population density in Bhatye creek, Ratnagiri was studied during February 2016 to January 2017.A total 23 species of crustacean zooplankton belonging to 18 families 20 genera were recorded. The highest abundance were represented by order Calanoida11 species each contributingabout48% by composition; followed by6 species of order harpacticoida (26%), 2 species of order cyclopoida (9%), 2 species of order poecilostomatoida (9%), diplostraca (4%) and decapoda (4%) in Bhatye creek. The analysis of results clearly showed a significant positive correlation amongst crustacean zooplankton except order decapoda'r' value at (p<0.01) level. Hence it revealed that the crustacean zooplankton abundance was well distributed in Bhatye creek except order decapoda, which showed spatial discontinuity in abundance.***

Keywords: Abundance, composition, crustacean zooplankton, correlation, Bhatye creek.

I. INTRODUCTION

Zooplankton composition constituted of copepods, cladocera, ostracods, amphipods, lucifers, siphanophora, mollusca, chaetognatha, decapod larvae, appendicularia, invertebrate eggs and fish larvae. They play crucial role in the food chain and energy flow in the aquatic ecosystem through interlinking the autotrophs and heterotrophs. Thus, it has been considered as bio-indicator and meaningful biological tool for assessing the trophic status of the aquatic environment. As crustacean zooplankton was qualitatively and quantitatively important group in zooplankton taxon with regard to their abundance in creek. Saravana kumar*et. al.,* (2007) reported a total of 69 species of which copepods formed the dominant group in different creekwater bodies, along western mangrove of Kutch, west coast of India. Hence, to understand the secondary and tertiary productivity, it is desirable that the systematic of the crustacean zooplankton is known. Milind*et. al.,* (2011) also investigated the response of the crustacean zooplankton community in improving water quality. They found that cyclopoids populations strongly decreased in freshwater while cladocerans did not change their abundance.

Although much work has been done all over the world; but crustacean zooplankton in creek, west coast of India is less well-studied. Only few reports on the zooplankton of creek water accessible from coastal population centres. Under estuarine conditions a freshwater zooplankton assemblage would be unlikely to survive, however may provide short-term food resources for, for example, estuarine macro-invertebrates or juvenile fish. Consequent upon this, there is a need for information on the dynamics of crustacean zooplankton diversity in the Bhatye creek of Ratnagiri coast.The phyla of zooplankton (Crustacea) were encountered during this investigation with the former being more diverse and abundance.

II. MATERIALS AND METHODS

A. Study area

Bhatye creek located at Latitude $16^0$58'13.57" North and Longitude, $73^0$18'28.10" East, Ratnagiri, west coast of India; where river Kajali meets the Arabian Sea.

B. Sample collection

Sample was collected fortnightly interval in each month by picking up method developed by Matasaka*et. al.,* (2002).Eight samplingsites were selected along the length of Bhatye creek. Each site is 0.75 to 0.8 Km away from each other.A total 100 litres of water was filtered by using simple conical tow plankton net (65 µm bolting nylon cloth)and then concentrated sample transferred in 50ml plastic bottle and later it was preserved in 5% neutralised formaldehyde solution and stain with eosin. Species were then

identified by using available keys (Strickland and Parsons, 1960; Kasturirangan, 1963; Dumont and Tundisi, 1984; Zheng Zhong*et. al.*, 1989; Santhanam and Srinivasan, 1994; Perumal*et. al.*, 1999 and Conway and White, 2003).

C. Crustacean zooplankton density counting

Total Enumeration of crustacean zooplankton wasdone on natural unit count and reported as units ororganisms per mL, method described by APHA, (1998).Population density count was done by 'Lacky's drop count method' (1998). Average of eight sampling site counts for each sample was taken into account. The results were tabulated as Simple Pearson's correlation coefficient matrix.

III. RESULTS

A total 23 species of crustacean zooplanktons belonging to 18 families and 20 genera were recorded from Bhatye creek, Ratnagiri coast. Species diversitywasfound from

Taxonomic group	Genus/Species
Calanoida	Calonopiaelliptica(Dana, 1849)
	Pontellinaplumata(Dana, 1849)
	Pontellafera(Dana, 1849)
	Calanopia minor(Scott A., 1902)
	Scolecithrixdanae(Lubbock, 1856)
	Acrocalanuslongicornis(Giesbrecht, 1888)
	Eucalanuscrassus(Giesbrecht, 1888)
	Haloptilusspiniceps(Giesbrecht, 1892)
	Metacalanusaurivilli(Cleve, 1901)
	Heliodiaptomusviduus(Gurney, 1916)
	Clausocalanus minor(Sewell, 1929)
Harpacticoida	Euterpinaacutifrons(Dana, 1847)
	Clytemnestra scutellata(Dana, 1848)
	Miraciaefferata(Dana, 1849)
	Longipediacoronata(Claus, 1862)
	Longipediaweberi(Scott A., 1909)
	Microsetellanorvegica(Boeck, 1864)
Cyclopoida	Oithonabrevicornis(Giesbrecht, 1891)
	Oithonaoculata(Farran, 1913)
Poecilostomatoida	Oncaea media(Giesbrecht, 1981)
	Sapphirinagastrica(Giesbrecht, 1891)
Diplostraca	Leptodorakindtii(Focke, 1844)
Decapoda	Lucifer penicillifer(Hansen 1919)

Table-1: Checklist of crustacean zooplankton species fromBhatyecreek, Ratnagiri.

eight prefixed sampling sites, which is shown in table 2 are as follows:Calonopiaelliptica, Pontelllinaplumata,Pontellafera, Calanopiaminor,Scolecithrixdanae, Acrocalanuslongicornis, Eucalanuscrassus, Haloptilusspiniceps, Metacalanusaurivilli, Heliodiaptomusviduus, Clausocalanus minor, Euterpinaacutifrons, Clytemnestra scutellata, Miraciaefferata, Longipediacoronata, Longipediaweberi, Microsetellanorvegica, Oithonabrevicornis, Oithonaoculata, Oncaea media, Sapphirinagastrica, Leptodorakindtiiand Lucifer penicillifer.

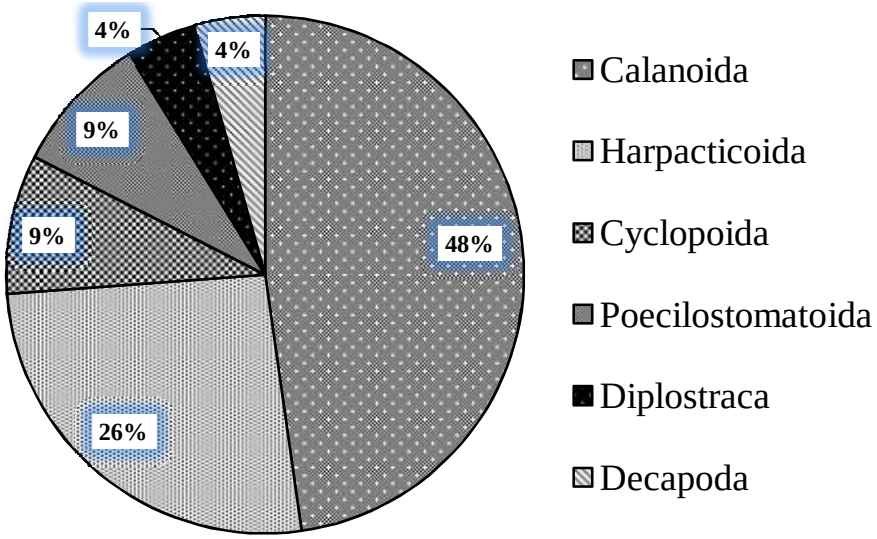

Figure-1: Species distribution in each taxonomic group of crustacean zooplankton.

In the present investigation the figure 1 clearly shows that crustacean zooplankton, order calanoida show highest species distribution thanother; as well as least species distribution shows order decapoda in Bhatye creek. The group abundance of individuals is

Species order	Calnoida	Harpacticoida	Cyclopoida	Poecilostomatoida	Diplostraca	Decapoda
Calnoida	1	0.992031**	0.995326**	0.90729**	0.960898**	0.69967*
Harpacticoida		1	0.975226**	0.953041**	0.988129**	0.784113*
Cyclopoida			1	0.86244**	0.929665**	0.6274*
Poecilostomatoida				1	0.988252**	0.93524**
Diplostraca					1	0.870149**
Decapoda						1

(** = significant 'r' value at 1% (P<0.01); *= significant 'r' value at 5% (P<0.05)

Table -2: Pearson's correlation coefficient of crustacean zooplanktonfrom Bhatyecreek.

presented in figure 1 showed, ordercalanoida were represented by 11 species with highest abundance and each species consisting of 48% by composition; and followed as 6 species of order harpacticoida consisting (26%), 2 species of order cyclopoida (9%), 2 species of order poecilostomatoida (9%), order diplostraca (4%) and last, order decapoda consisting 4%by composition in Bhatye creek. The dominance of order calanoida in the study area is common to all sampling sites. In present study table 3 and 4 shows, monthly species population density of crustacean zooplankton; and average of monthly crustacean zooplankton species population density (organism/litre) showed in figure2I, II, III, IV, V and VI. The results clearly showed a significant positive correlation amongst crustacean zooplankton species except order decapoda'r' value at (p<0.01) level (Table 2).

IV. DISCUSSION

The zooplankton composition influenced by so many factors and they change according to ecological changes. Tropical aquatic ecosystems are the most productive areas with rich zooplankton population foundby Robertson *et. al.*, (1992) and Saravankumar*et.al.,* (2007). The zooplankton, as the basis of the tropic chain, constitutes the most important biological community in any aquatic system. Such information is of much importance in estimating the energy available to higher tropic levels which in turn can be used to estimate harvestable fishery resources. In present study, Twenty three species of crustacean zooplanktons belonging to eighteen families and twenty genera from Bhatye creek, Ratnagiri coast were recorded.

Our results indicate that order calanoida show highest distribution than other crustacean zooplankton species; as well as least distribution shows order decapodain Bhatye creek.An almost similar result has been reported by Kulkarni and Mukadam, (2015) from Bhatye estuary, Ratnagiri, Maharashtra, he also found 25 species of crustacean zooplanktons, and prepare check list of same. However, it compared favourably with the reported 23 species.The present results clearly showed a significant positive correlation amongst crustacean zooplankton species except order decapoda 'r' value at ($p<0.01$) level (Table 2). The group abundance of individuals was presented,in which order calanoida were represented by 11 species with highest abundance and each species consisting of 48% by composition; and followed as 6 species of order harpacticoida (26%), 2 species of order cyclopoida (9%), 2 species of order poecilostomatoida (9%), 1 species of order diplostraca (4%) and last 1 species of order decapoda (4%) in Bhatye creek.

The difference in the number ofzooplankton species in this study and other studies may beattributed to the natural conditions of water bodies and time of sampling. Rao, (1977) studying on the distribution of warm water zooplankton in Indian estuaries and documented that, seasonal variation of salinity in Cochin backwaters. Madhupratap (1980 and 1981) observed the co-existence of copepods and cladocerans of estuarine and coastal waters of South west coast of India. Santhakumari*et. al.*, (1999) reported species composition, abundance and distribution of hydromedusae from Dharmatar estuarine system.

V. CONCLUSION

The dominance of order calanoidais common in Bhatye creek. Present study revealed that, a significant positive correlation amongst crustacean zooplankton except order decapoda'r' value at ($p<0.01$) level;these differences are attributed to duration of sampling, natural conditions of the water bodies and may polymodal occurrence of crustacean zooplankton. This abundance well distributed in Bhatye creek except, order decapods which showed spatial discontinuity in abundance. Research into the composition and abundance of crustacean zooplankton in Bhatye creek is important to determine their occurrence in natural conditions; and are used to assess the biological integrity of the water body, also used in bio-monitoring of pollution.

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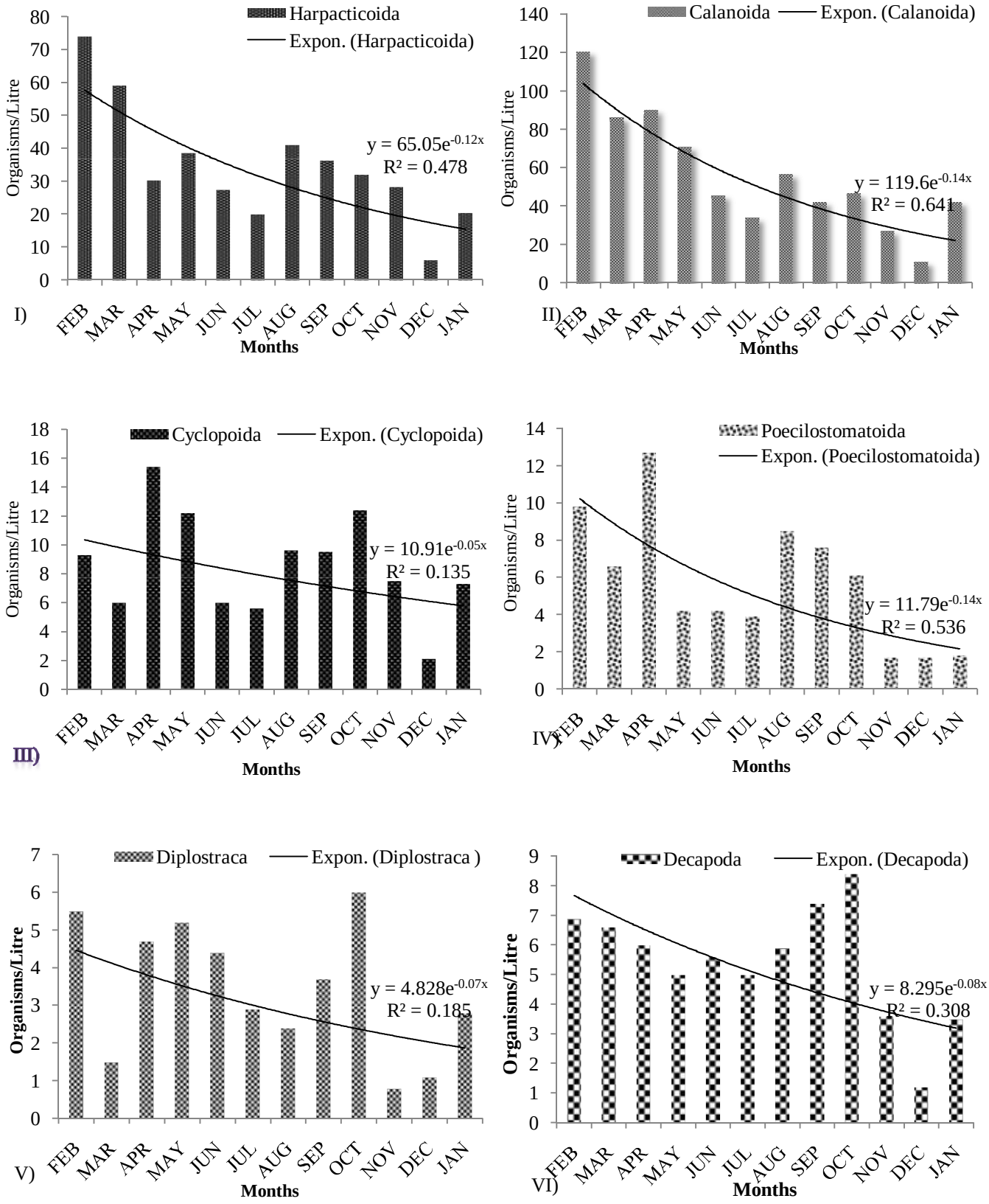


Figure–2: I, II, III, IV, V and VI:Showing monthly variation in abundance of crustacean zooplankton from Bhatye creek during year 2015 to 2017.

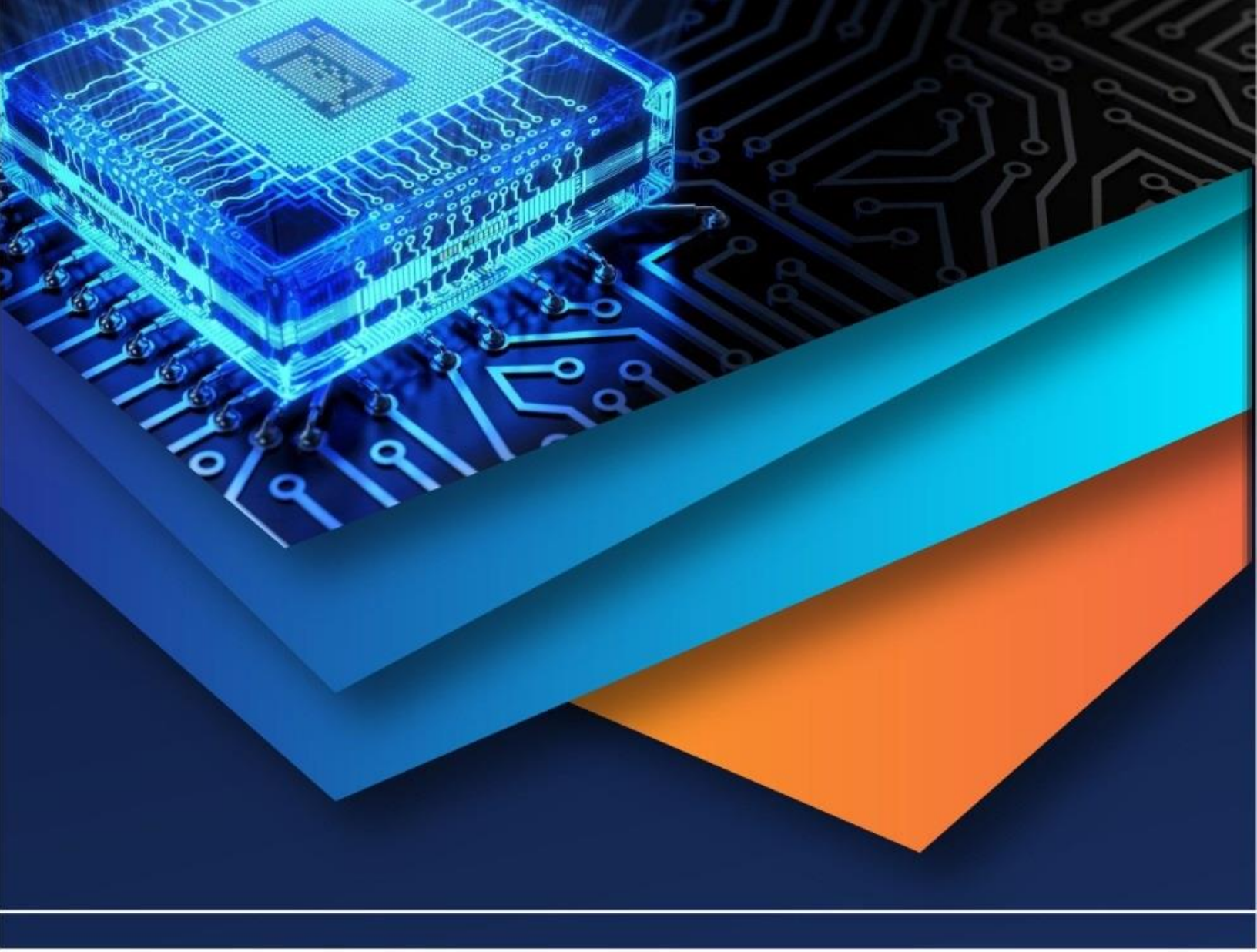
Family	Species Name	Months												Total	Average	Percentage
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN			
Calanoida	Calonopiaelliptica	7.7	2.7	11	7.3	6.4	3.7	3.9	2.4	2.8	0.5	0.8	0.6	49.8	4.2	7.6
	Pontellinaplumata	9.2	4.7	7.6	4.7	9	6.7	3.6	5.9	3.2	1.5	0.8	0.5	57.4	4.8	8.8
	Pontellafera	7.6	5.2	4.4	5.1	8	4.9	4.4	5.2	5.5	1.8	0.7	0.5	53.3	4.4	8.2
	Calanopia minor	6	1.8	4.6	4	10.5	8.3	5.7	3.7	3.5	2.6	1.3	0.7	52.7	4.4	8.1
	Scolecithrixdanae	10.4	12	3.8	8.2	5.3	8.5	7.1	4.8	4.5	3.1	0.8	1.1	69.6	5.8	10.6
	Acrocalanuslongicornis	9.7	4.5	14.3	11.2	8.7	5.3	4.5	3.9	6.3	4	1.2	0.5	74.1	6.2	11.3
	Eucalanuscrassus	9	5.6	7.1	1.8	1.5	2.1	3.8	7.9	8	2.6	0.9	0.6	50.9	4.3	7.8
	Haloptilusspiniceps	14.6	7.9	7.4	12	11.4	8.2	10.9	4.7	5.7	4.3	1	0.6	88.7	7.4	13.6
	Metacalanusaurivilli	13.9	8.5	1.1	7.9	9.8	4.7	5.3	2.9	2.7	2.3	0.8	0.9	60.8	5.1	9.3
	Heliodiaptomusviduus	12.3	6.6	12.8	3.6	1.8	3.5	4.4	3.8	1.8	0.4	0.5	1.6	53.1	4.4	8.1
	Clausocalanus minor	12.9	4.1	6.2	8.6	1.1	1.3	0.9	2.2	3.8	1.5	0.6	0.9	44.1	3.7	6.7
	TOTAL	113.3	63.6	80.3	74.4	73.5	57.2	54.5	47.4	47.8	24.6	9.4	8.5	654.5	54.5	100
Harpacticoida	Euterpinaacutifrons	7.4	2.6	1.8	2.7	14.5	11.3	11	4.5	4.8	4.7	1	0.9	67.2	5.6	8.1
	Clytemnestra scutellata	9.9	4.1	6.5	5.6	5	2.8	5.3	5	0.6	0.9	1.1	0.9	47.7	4	5.8
	Miraciaefferata	13	10.9	5.6	3.1	0.9	1.6	4.2	6.1	4.3	2.7	0.9	0.7	54	4.5	6.5
	Longipediacoronata	7.8	2.5	4.6	436	1.1	1.6	6.9	11.1	8.6	4.3	0.9	0.8	486.2	40.5	58.7
	Longipediaweberi	12.1	7.9	3.7	15.1	16	11.4	3.8	5	10.7	8.7	0.9	0.8	96.1	8.0	11.6
	Microsetellanorvegica	18.8	12	1.1	4.9	8.9	6.2	7.1	8.5	5.5	3.5	0.7	0.4	77.6	6.5	9.4
	TOTAL	69	40	23.3	467.4	46.4	34.9	38.3	40.2	34.5	24.8	5.5	4.5	828.8	69.1	100
Cyclopoida	Oithonabrevicornis	3.8	1.1	11.8	11.4	3.4	6	3.9	5.4	4.3	6.8	0.9	0.6	59.4	5	55.5
	Oithonaoculata	4.8	7.4	3.2	2	4.9	4.1	5.5	3.8	9.6	0.6	1.1	0.7	47.7	4	44.5
	TOTAL	8.6	8.5	15	13.4	8.3	10.1	9.4	9.2	13.9	7.4	2	1.3	107.1	8.9	100
Poecilostomatoida	Oncaea media	1.9	0.8	8.4	1.1	5.2	4.1	3.3	6	4.2	0.3	0.7	0.9	36.9	3.1	51
	Sapphirinagastrica	9	9.1	2.5	1.1	0.9	1.9	4.2	2.9	1.4	1.1	0.6	0.7	35.4	3	49
	TOTAL	10.9	9.9	10.9	2.2	6.1	6	7.5	8.9	5.6	1.4	1.3	1.6	72.3	6	100
Diplostraca	Leptodorakindtii	5.1	1.4	3.4	5.9	6.8	5.2	3.9	4.3	7.4	0.4	1	0.4	45.2	3.8	100
	TOTAL	5.1	1.4	3.4	5.9	6.8	5.2	3.9	4.3	7.4	0.4	1	0.4	45.2	3.8	100
Decapoda	Lucifer penicillifer	6.6	6.4	7	5.9	9.2	9.2	8.2	8.2	10.2	2.6	1.1	1.5	76.1	6.3	100
	TOTAL	6.6	6.4	7	5.9	9.2	9.2	8.2	8.2	10.2	2.6	1.1	1.5	76.1	290.1	100

Table -3: Monthly species population density (org./lit.) of crustacean zooplanktonsampled from Bhatye creek during February 2015 to January 2016

Family	Species Name	Months												Total	Average	Percentage
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN			
Calanoida	Calonopiaelliptica	11.6	8	10.1	5.7	1.5	0.6	3.3	1.9	2.7	0.6	0.9	7.4	54.3	4.5	7.9
	Pontellinaplumata	11.3	8.8	4.6	10.5	1	0.6	3.9	5	4.4	1.1	1	4.8	57	4.8	8.2
	Pontellafera	8	7.8	7.9	7.2	1.1	1	3.3	4.7	5.5	3.4	1.2	5.5	56.6	4.7	8.2
	Calanopia minor	7.9	2.6	7.3	7.8	1.2	0.8	2.7	3.5	4.5	3.3	1	4	46.6	3.9	6.7
	Scolecithrixdanae	11.9	10.1	15.3	6.5	0.8	0.9	5.5	2.7	4.3	4.1	1.6	7.3	71	5.9	10.2
	Acrocalanuslongicornis	12	15.8	16.4	6.9	0.9	1.3	7.9	3	6.2	4.5	1.5	10.8	87.2	7.3	12.7
	Eucalanuscrassus	8.7	8.9	7.1	1.6	1.4	1	5	3.7	8	1.2	1.2	1.9	49.7	4.1	7.2
	Haloptilusspiniceps	15.2	8.1	10.1	10.9	3.1	0.9	12	3.9	4.3	3.9	1.1	13.2	86.7	7.2	12.6
	Metacalanusaurivilli	14.5	6.6	2	8	2.4	1.1	6.8	2.3	1	3.2	1.1	6.9	55.9	4.7	8.1
	Heliodiaptomusviduus	12.2	17.1	12.6	1.4	2.8	1.5	6.1	4.5	1.6	3	1.1	5	68.9	5.7	10
	Clausocalanus minor	14.7	14.9	6.7	0.9	1.4	0.7	2.6	1.7	2.9	0.8	0.9	9.1	57.3	4.8	8.3
	TOTAL	128	108.7	100.1	67.4	17.6	10.4	59.1	36.9	45.4	29.1	12.6	75.9	691.2	57.6	100
Harpacticoida	Euterpinaacutifrons	10.2	6.2	3.5	10	1.5	1	7.6	4.9	4.2	4	1	2.8	56.9	4.7	13.4
	Clytemnestra scutellata	8.6	18.1	5.1	7.1	1.4	0.5	5.9	4.5	1.8	0.8	1	3.6	58.4	4.9	13.7
	Miraciaefferata	14.7	8.5	6.9	1.6	1.1	0.7	9	3.9	5.8	1.2	1.4	2.9	57.7	4.8	13.6
	Longipediacoronata	9.5	9.1	7.9	0.7	1	0.7	8.5	8.7	6.3	5.7	1.1	5.3	64.5	5.4	15.2

	Longipediaweberi	13.4	21.9	8.6	16.6	1.5	1.3	5.2	5.7	6.4	15.1	1	15.6	112.3	9.3	26.4
	Microsetellanorvegica	22.6	9	5.4	5.2	2.1	1	7.7	4.8	5	5.2	1.1	6.2	75.3	6.3	17.7
	TOTAL	79	72.8	37.4	41.2	8.6	5.2	43.9	32.5	29.5	32	6.6	36.4	425.1	35.4	100
Cyclopoida	Oithonabrevicornis	5.9	2.2	11.1	5.6	1.7	0.5	3.8	6.1	4.3	6.9	1.3	11.2	60.6	5.1	61.8
	Oithonaoculata	4	1.2	4.7	5.3	2	0.5	6	3.7	6.5	0.7	0.8	2	37.4	3.1	38.2
	TOTAL	9.9	3.4	15.8	10.9	3.7	1	9.8	9.8	10.8	7.6	2.1	13.2	98	8.2	100
Poecilostomatoida	Oncaea media	1.9	1	10.4	5.2	1.1	1	4.2	4.6	4.2	1.4	1.1	0.8	36.9	3.1	57.1
	Sapphirinagastrica	6.8	2.3	4.1	0.9	1.1	0.7	5.2	1.7	2.3	0.6	0.9	1.1	27.7	2.3	42.9
	TOTAL	8.7	3.3	14.5	6.1	2.2	1.7	9.4	6.3	6.5	2	2	1.9	64.6	5.4	100
Diplostraca	Leptodorakindtii	5.9	1.5	5.9	4.4	1.9	0.6	0.8	3.1	4.6	1.1	1.1	5.2	36.1	3	100
	TOTAL	5.9	1.5	5.9	4.4	1.9	0.6	0.8	3.1	4.6	1.1	1.1	5.2	36.1	3	100
Decapoda	Lucifer penicillifer	7.1	6.7	4.9	4	1.9	0.7	3.6	6.6	6.5	4.6	1.2	5.4	53.2	4.4	100
	TOTAL	7.1	6.7	4.9	4	1.9	0.7	3.6	6.6	6.5	4.6	1.2	5.4	53.2	223.6	100

Table -4: Monthly species population density (org./lit.) of crustacean zooplankton sampled from Bhatye creek during February 2016 to January 2017.



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45.98

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IMPACT FACTOR: 7.429

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