ECOLOGICAL INDICES OF FRESHWATER COPEPODS AND CLADOCERANS FROM DHARMAPURI DISTRICT, TAMIL NADU

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ABSTRACT

Four copepods and seven cladoceran species were identified in the zooplankton samples collected from fifty freshwater bodies, in and around Dharmapuri District, Tamil Nadu including during September 1999 and April, 2000. Ecological indices for similarity and dissimilarity, index of dominance, index of diversity, index of evenness and species richness indicate variations pertaining to winter and summer zooplankton density. Zooplankton populations of winter and summer are discussed.

KEYWORDS

Copepods, cladocerans, dominance, diversity, evenness, species richness

Zooplankton populations of tropical freshwater bodies depend on the primary productivity and physico-chemical parameters. Copepods and cladocerans constitute the dominant groups of freshwater habitat. They inhabit the ponds, lake, rivers and reservoirs and reported to occur more abundantly in ponds and lakes than in rivers (Reid, 1986; Raghunathan, 1983; Sharma, 1991). Some genera of copepods and cladocerans are cosmopolitan in distribution, while others are restricted to some continents (Brooks, 1959; Williamson, 1991). Depth of the pond, water transparency, pH and predators determine the distribution and abundance of copepods (Confer *et al.,* 1983; Patalas, 1971). Dussart (1984) reviewed the systematic and distribution of tropical freshwater zooplankton from all over the world.

The successions of zooplankton populations depend upon the interspecific and intraspecific interaction and predation potential (Fernando, 1980). There has been some report on the species composition and species diversity of harpacticoid copepod in tropical reef lagoon (Villers & Bodiou, 1996). The freshwater bodies such as ponds, lakes, rivers and reservoirs of Dharmapuri district, Tamil Nadu characterize tropical freshwater ecosystem. The present paper deals with the copepod and cladoceran populations of fifty freshwater bodies with regard to ecological indices of winter and summer populations.

MATERIALS AND METHODS

Zooplankton samples were collected during September, 1999 (winter) and April, 2000 (summer) from fifty freshwater bodies of Dharmapuri District, Tamil Nadu. Samples were collected during early hours of the day (6.00am), using a plankton net made up of bolten silk (mesh size 100µm)

During the study period temperature and pH of the water sample were recorded. The samples were preserved in 5% neutral buffer formalin for qualitative analysis and identified following the taxonomic keys provided by Rajendran (1973), Pennak (1978), Tonapi (1980), Barnes (1982), Battish (1992), Maas (1994), Reddy (1994) and, Dussart and Defaye (1995) for copepods and Michael (1973), Venkataraman (1983), Sharma and Michael (1987), Raghunathan (1989) and Murugan *et al.* (1998) for cladocerans. For quantitative analysis, 100L of water sample was filtered through the plankton net and the plankton sample was carefully transferred with out any loss to a plastic container and preserved in 5% neutral buffer formalin.

Copepods and cladocerans were enumerated using Sedgewick-Rafter chamber following Santhanam *et al.* (1989). The data was analyzed for ecological indices such as similarity and dissimilarity, index of dominance, index of diversity, index of evenness and species richness following the methods described by Odum (1983).

RESULTS

Copepods and cladocerans recorded from fifty freshwater bodies of Dharmapuri District, Tamil Nadu were:
Copepods: 1. *Heliodiaptomus viduus* 2. *Sinodiaptomus* (*Rhinediaptomus*) *indicus* 3. *Thermocyclops hyalinus* 4. *Mesocyclops aspericornis* 5. copepodid and 6. *nauplii*
Cladocerans: 1. *Daphnia carinata* 2. *Moina micrura* 3. *Moina brachiata* 4. *Diaphanasoma sarsi* 5. *Diaphanasoma excisum* 6. *Ceriodaphnia cornuta* and 7. *Alona quadrangularis*.
Temperature and pH were normal in range (30±2ºC & 6.3-8 respectively).

In dissimilarity analysis values were divided into four ranges i) 0.1-0.25, ii) 0.26-0.50, iii) 0.51-0.75 and iv) 0.76-1.00 and were framed as matrices. In winter season, dissimilarity values of *H. viduus* and *S. (R.) indicus* and, *S. (R.) indicus* and *T. hyalinus* were in the range of 0.51-0.75 and other animal dissimilarity values were in the same range (0.76-1.00). Different species of copepods showed similar range of dissimilarity (0.51-0.75) in summer season (Fig. 1).

In cladocerans, during winter season *D. sarsi* and *M. micrura* showed lesser dissimilarity values (0.1-0.25). Range of dissimilarities values for *D. sarsi* and *C. cornuta* and, *C. cornuta* and *M. micrura* were 0.26-0.50, *D. carinta* and *M. micrura* showed 0.51-0.76, while in other cladocerans it ranged between 0.76-1.00. During summer season, *D. sarsi* and *M. micrura* and, *D. sarsi* and *C. cornuta* showed dissimilarity range of 0.51 – 0.75, however, *M. micrura* and *C. cornuta* showed a range of 0.26 – 0.50, while other cladocerans showed similar range (0.76-1.00) (Fig. 1-4).

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Table 1. Ecological indices of planktonic copepods and cladocerans in winter (Sep., 1999) and summer (Apr., 2000) seasons in Dharmapuri District

Zooplankton	Winter				Summer			
	C	H	e	d	C	H	e	d
Copepods								
Heliodiaptomus viduus	0.0023	4.2147	2.3522	1.0965	0.0057	2.7293	1.6958	0.6993
Sinodiaptomus (*Rhinediaptomus*) *indicus*	0.0049	2.7293	1.5232	0.8206	0.0041	2.8734	1.7854	0.7207
Thermocyclops hyalinus	0.0676	1.6071	0.8969	0.6748	0.2959	1.1528	0.7163	0.5202
Mesocyclops aspericornis	0.0006	3.7537	2.0949	0.9921	-	-	-	-
Copepodid	0.0910	1.5040	0.8394	0.6614	0.0253	1.9979	1.2414	0.6182
nauplii	0.1090	1.4387	0.8209	0.6536	0.0246	2.0085	1.2480	0.6202
Cladocerans								
Daphnia carinata	0.0026	3.0269	1.8808	0.7561	-	-	-	-
Moina micrura	0.0083	1.5279	0.9494	0.5674	0.0543	1.6997	1.0561	0.6462
Moina brachiata	-	-	-	-	0.0008	3.5695	2.2179	0.9770
Diaphanasoma sarsi	0.1013	1.4594	0.9068	0.5602	0.0418	1.7706	1.1001	0.6600
Diaphanasoma excisum	0.00004	5.0735	3.1524	1.2461	-	-	-	-
Ceriodaphnia cornuta	0.1107	1.4.387	0.8939	0.5571	0.2836	1.1649	0.7258	0.5698
Alona quadrangularis	-	-	-	-	0.000002	6.5727	4.0839	3.6430

C - index of dominance, H – index of diversity, e – index of eveness, d – species richness

Higher index of dominance was recorded in *nauplii* (0.1090) and copepodid (0.0910) of copepods and *T. hyalinus* (0.0676). Among cladocerans, *C. cornuta* (0.1107) *D. sarsi* (0.1013) and *M. micrura* (0.0853) showed high dominance value. In summer season, *T. hyalinus* and *C. cornuta* showed highest dominance of 0.2959 and 0.2836 respectively, while *A. quadrangularis* was least dominant (0.000002) (Table.1).

In winter, Diversity, abundance and density values for *H. viduus* were 4.2147, 2.3522 and 1.0965, for *M. aspericornis* 3.7537, 2.0949 and 0.9921, for *S. (R.) indicus* 2.7293, 1.5232 and 0.8206, for *D. excisum* 5.0735, 3.1524 and 1.2461 and for *D. carinata* 3.0269, 1.8088 and 0.7561 respectively. In summer season, *S. (R.) indicus, H. viduus, nauplii* of copepods, *A. quadrangularis* and *M. brachiata* showed high diversity, abundance and density, while *T. hyalinus* (1.1528, 0.7163 and 0.5202) and *C. cornuta* (1.1649, 0.7258 and 0.5698) showed lowest diversity, abundance and density. *M. brachiata* and *A. quadrangularis* were absent in winter, while *M. aspericornis, D. carinata* and *D. excisum* were absent in summer (Table. 1).

Discussion

In this study *H. viduus* and *S. (R.) indicus, S. (R.) indicus* and *T. hyalinus* showed similar dissimilarity range in both the seasons, but *H. viduus* and *T. hyalinus* showed similar range during summer season, whereas in winter season other copepods showed similar range (0.76-1.00).

In cladocerans, species dissimilarity ranged between 0.76-1.00 during winter and summer season and showed 6 and 7 combinations respectively. Nishida (1985) stated matrix of dissimilarity of coefficient of Oithoninae family of genera *Oithona* sp. and *Paroithona* sp., which is a dense assemblage of closely allied species.

High dominance of species was recorded during winter season than in summer but *T. hyalinus* and *C. cornuta* showed high dominance during summer season in fifty samples. In the samples, one or two species dominated during study period such type of results have been reported by Villers and Bodiou (1996).

Index of diversity of the present study showed *H. viduus* and *D. excisum* with high value in winter and, *S. (R.) indicus* and *A. quadrangularis* with high value in summer. Lyons (1981) had shown that biomass or productivity, which are often more ecologically appropriate, can be used in such statistical tests if number of individuals are also known.

Odum (1983) suggested that two broad approaches are used to analyse species diversity in different situations of dominance – diversity, relative abundance curves and diversity indices, which are ratios or other mathematical expression of species importance relationships.

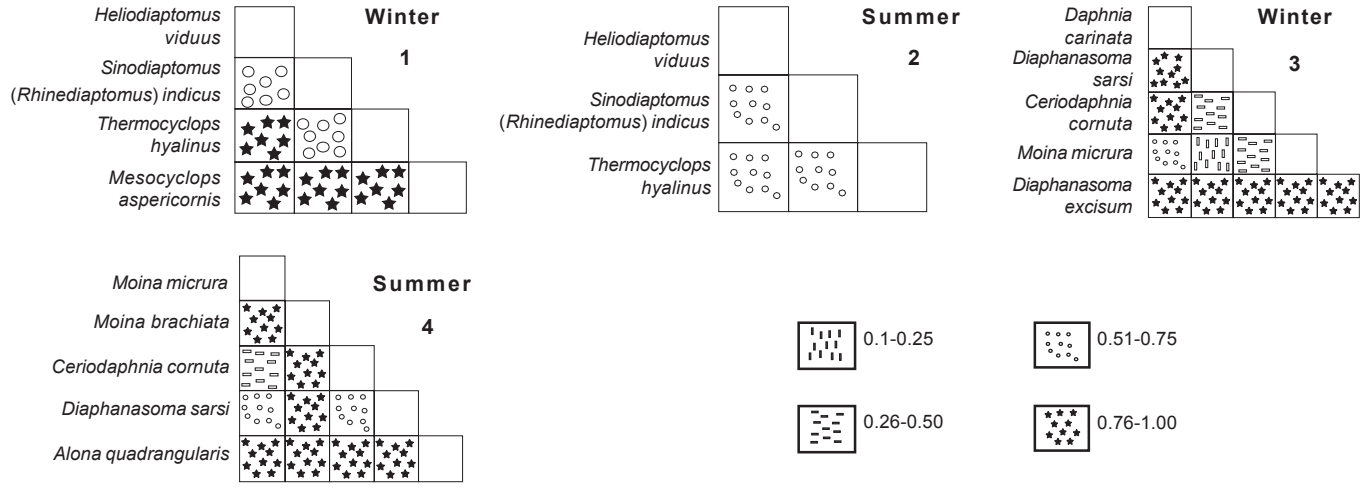
In the present study, abundance and density increased with diversity value. Diversity is directly related to abundance or equitability (Odum, 1983). Villers and Bodiou (1996) reported that, harpacticoid copepods showed lowest values of diversity and equitability, but the greatest degree of dominance in single species. Similar type of results were obtained with regard to ecological indices, which also coincide with Odum (1983) that the dominance value is inversely proportional to values of diversity, evenness and species richness.

Species diversity is reported to be influenced by the functional relationships between the tropic levels. The amount of predation greatly affects the diversity of prey population (Odum, 1983). The reason for low diversity values of nauplii and copepodid of copepods and *C. cornuta* recorded in the present study might be that, they are preferred by predators (fish).

References

Barnes, R.D. (1982). *Invertebrate Zoology.* Saunders College. Philadephia. Japan.

Battish, S.K. (1992). *Freshwater Zooplankton of India.* Oxford IBH Publishing Co. Pvt. Ltd. New Delhi.



Figures 1-4. Matrices of dissimilarity values of copepods and cladocerans during winter and summer seasons

Brooks, J.L. (1959). Cladocera. In: Edmondson, W.T. (editor). *Freshwater Biology.* John Wiley & Sons, New York. Pp.587-656.

Confer, J.L. T. Kaaretand G.E. Likens (1983). Zooplankton diversity and biomass in recently acidified lakes. *Canadian Journal of Fisheries and Aquaculture Science* 40: 36-42.

Dussart, B.H. (1984). Some Crustacea Copepoda from Venezuela. *Hydrobiologia* 113: 25-64.

Dussart, B.H. and D. Defaye (1995). *Copepoda. Introduction to the Copepoda.* SPB Academic Publishing, Netherlands. 253pp.

Fernando, C.H. (1980). The freshwater Zooplankton of Sri Lanka with a discussion of tropical freshwater zooplankton cosmopolitan. *International Reviews Gesture of Hydrobiologia.* 65pp.

Lyons, N.L. (1981). Comparing diversity indices based on counts weighted by biomass or other importance values. *American Nature* 118: 438-442.

Maas, S. (1994). *Introduction to the copepoda.* International Training Course: Lake Zooplankton: a tool in lake management 218pp.

Michel, R.G. (1973). Cladocera: A guide to the study of freshwater organisms. *Journal of Madurai University, Supplement* 1*:* 71-85.

Murugan, N., P. Murugavel and M.S. Kodarkar (1998). *Cladocera*. Indian Association of Aquatic Biologist. 55pp.

Nishida. S. (1985). Taxonomy and distribution of the family Oithonidae (Copepoda, Cyclopoida) in the Pacific and Indian Oceans. *Bulletin of the Ocean Research Institute University of Tokyo* 20: 1-167.

Odum, E.P. (1983). *Basic Ecology.* Holt-Saunders International Editions. Saunders College Publishing. Japan, 558pp.

Patalas, K. (1971). Crustacean plankton communities in forty-five lakes in the experimental lakes area, North Western Ontario. *Journal of Fisheries Research Board of Canada* 28: 231-244.

Pennak, R.W. (1978). *Freshwater Invertebrates of the United States,* 2nd edition. John Wiley and Sons, New York, 803p.

Raghunathan, M.B. (1983). Studies on some planktonic cladocerans (Crustacea) of Tamil Nadu, Ph.D. Thesis, Madras Unversity (unpublished).

Raghunathan, M.B. (1989). Indian Cladocera (Crustacea). *Indian Review in Life Sciences* 9: 137-152.

Rajendran, M. (1973). Copepoda. In: Michael R.G.(Ed.) A guide to the study of freshwater organisms. *Journal of Madurai University, Supplement* 1: 103.

Reddy, Y.R. (1994). Guides to the identification of the microinvertebrates of the continental waters of the world. Dumont, H.J.F. (editor). *Copepoda: Calanoida: Diaptomidae.* SPB Academic Publications, The Netherlands, 221pp.

Reid, J.W. (1986). Some usually overlooked cryptic copepod habitats. Syllogeus. 58. Proceedings of Second International Conference on Copepoda, Ottawa, 84: 594-598.

Santhanam, R.P. Velayutham and G.Jegathesan. (1989). *A Manual of Freshwater Ecology.* Daya Publishing House, New Delhi.

Sharma, B.K. (1991). *Cladocera: Animal Resources of India.* pp. 205-223.

Sharma, B.K. and R.G. Michael (1987). Reviews of taxonomic studies on freshwater cladocera form India with remarks on biogeography. *Hydrobiologia* 145: 29-33.

Tonapi, G.T. (1980). *Freshwater Animals of India.* Oxford IBH publishing Co. Pvt. Ltd. New Delhi.

Venkataraman, K. (1983). Taxonomy and ecology of Cladocera of Southern Tamil Nadu. Ph.D. Thesis. Madurai Kamaraj University, Madurai.

Villers, L. and J.Y. Bodiou (1996). Community structure of harpacticoid copepods in a tropical reef lagoon (Fangataufa Atoll-French Polynesia). *Oceanologia Acta* 19(2): 155-162.

Williamson, C.E. (1991). *Copepoda. Ecology and Classification of North American Freshwater Invertebrates.* Academic Press, Inc. pp. 787-822.

Whittakar, R.H. (1960). Vegetation of the Siskiyou Mountains, Oregon and California. *Ecology Monography* 30: 279-338.

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