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SPECIES DIVERSITY INDICES AND RELATED HABITAT CHARACTERISTICS

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ABSTRACT

The species diversity indices based on Shanon-Weaver, Simposon and Margalef formulae as well as the evenness component of species diversity have been calculated for freshwater macrobenthic population and discussed in particular reference to the state of pollution of the habital, resource diversity, community stability and habitat suitability. It has been observed that the habitat is moderately polluted and the macrobenthic community is stable in the habital with diversified resources which are shared by the component species to a great extent.

INTRODUCTION

Although species diversity has been termed as a "non concept" by Hurlbert (1971) and meaningless because to him the diversity indices, which are necessarily linear in nature, do not represent the actual situation, is an extremely useful notion that can be defined as the effective number of species present (Hill, 1971) either in a broader geographic area, a community or a portion. Diversity can be quantified in a wide varieties of ways but its basic components are simply the actual number of the species and their relative importances, usually measured by relative abundances, biomass or productivity (Dickman, 1968; Whittaker, 1970, 1972). The former component number of species is variously referred to as `species richness' and/or species density. Various indices of diversity weight these two components rather differently (Hill, 1973) and some indices all but ignore one component or the other (Pianka and Huey, 1971). The present communication deals with species diversity of littoral macrobenthic fauna of a freshwater habitat located in the heart of coal city Dhanbad commonly known as Rajendra Sarovar (86°48" EL and 23°27" NL).

MATERIALS AND METHODS

Monthly sampling was done for one year (October 86 to September 87) following standard methods, described in detail else where (Sinha *et al.*, 1989). Seven samples were taken at a time and

Table 1. Seasonal Variation in Percentage Composition of Different Groups in Macrobenthic fauna (1986-87).

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Oligochaeta	59.54	53.18	46.29	71.91	38.44	24.67	16.30	10.70	13.17	34.48	42.55	61.57
Mollusca	11.81	12.49	16.29	3.55	16.30	4.63	5.63	2.36	2.45	13.97	8.85	9.98
Other insects	4.47	6.69	16.73	12.87	22.14	12.96	3.58	0.95	2.37	4.69	19.40	9.13
Chironomids	24.18	27.64	20.69	11.67	23.12	57.74	74.49	85.99	82.01	46.86	29.20	19.32

the values of the present communication are their mean. The date obtained on population densities (per square metre) of different species were calculated for the species diversity indices following the information theoretic index (Loguet-Higgins, 1971) of Shanon-Weaver (1949), Simpson (1949), Margalef (1958) and the evenness component of species diversity was calculated following Peilou (1969).

RESULTS AND DISCUSSION

The percentage composition of different groups of macrobenthos has been presented in the Table 1 while Fig. 1 (A, B, C, & D) embodies the seasonal variation in species diversity and also the evenness component of species diversity in the form of histograms.

Although several diversity indices have been proposed particularly on species richness and individual richness (Fisher *et al.*, 1943; Preston, 1948; Good, 1953; Brilloutin, 1960), and the study of species diversity has produced an extensive literature; some important and useful reviews include those of Mac Arthur (1965), Mc Intosh (1967), Whittaker (1972) and Peet (1974). One of the most promising indices of diversity measure is derived from the information theory (Margalef, 1956; Patton, 1962; Wilhm & Dorris, 1966; Mathis; 1968). Such measures relate to uncertainty that exists regarding the species of an individual selected at rondom from a population. The greater the number of species present and/or the more evenly individuals are apportioned along the species, the greater to uncertainty in selection, and

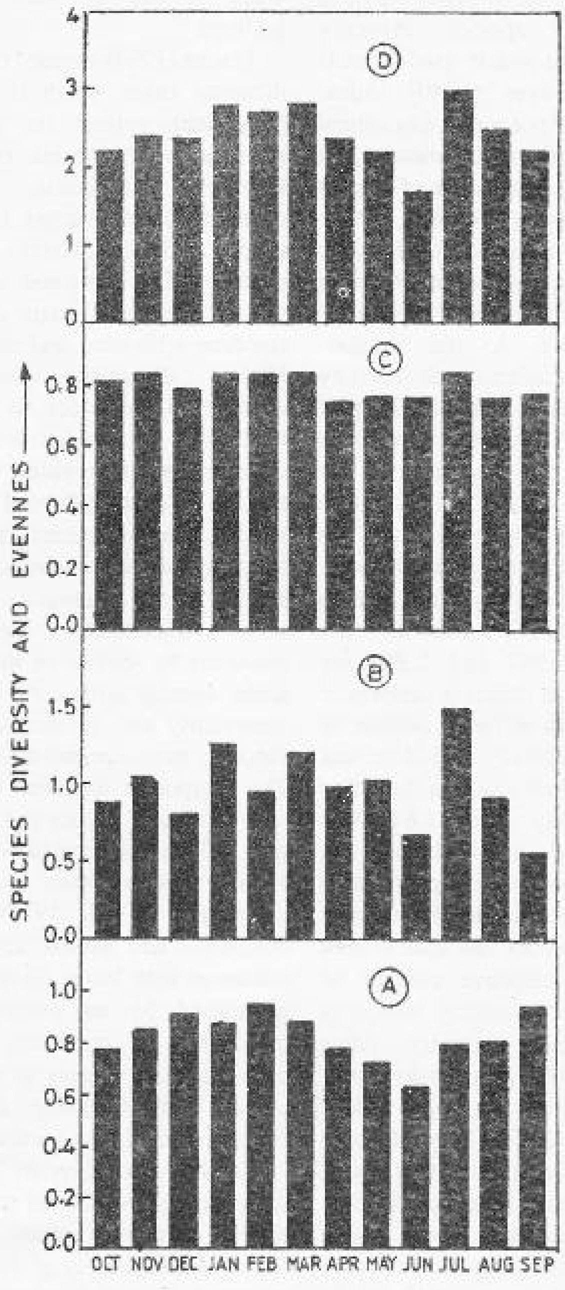

Fig. 1. Seasonal variation in evenness A, and species diversity indices by margalef B, by Simpson C, & by Shanon-Weaver D, formulae.

hence the greater the diversity value. In estimating the species diversity probably the most widely used index is the Shanon-Weaver (1940) index, which actually is not a real assessment of species diversity in community but the relative importance value of species taken into account (Whittaker, 1977). This is why the index obtained by the formula is good indication of water quality of the habitat and forms a base of biomonitoring. As the Shanon-Weaver diversity index is calculated by dividing the density or productivity of one species by the total importance value of all the species in the community it reveals the relative importance of species in the community rather than the diversity itself. As evident by the results obtained three nearly equal diversity values 2.391, 2.367 and 2.350 are derived from three different samples of different size with different number of species *viz.*, 17-329/m^2, 16-524/m^2 and 18-1266/m^2 respectively. On the other hand the diversity value 1.647 was obtained for the sample having six species (June) while a higher value 2.203 was obtained for the sample with lower species number and thus it does not reflect the effective number of species in the community which is called as species diversity. After application of the relationships put forward by Whilhm and Dorris (1966) and Staub *et al.* (1970) between these diversity values and pollution status of the water body it can be concluded that according to Whilhm & Dorris (1966) the habitat is moderately polluted (sp. diversity 1-3); While according to the explanation of Stabu *et al.* it has light pollution (sp. diversity 2-3) except in the month June (sp. diversity 1.647) when it can be said moderately polluted.

Pianka (1974) stressed on Simpson's diversity index which is sample size dependent, reflect the proportional abundance of species richness and individual richness. Simpson's diversity index varied from 0.5711 (Sept.) to 0.8407 (March). Mac Arthur (1965, 1972) explained the diversity variation on the basis of resource, resource utilization and niche overlap. Higher diversity values reflect diversified resources in the habitat available for components of the community. Decreased values of species diversity indicated the increase by an average species resulting into lowering of the number of coexisting species in the community. Apart from these two conditions, the sharing of resources by species or the amount of niche overlap affects the diversity. A community with greater niche overlap supports more species and *vice versa.* The Simpons's diversity index varies between 0 to 1. Hence the values more than 0.5 can be considered as higher values, thus following Mac Arthhur's explanation (1965, 1972) it can be concluded that habitat has diversified resources with lower diversity of their utilization by an average species, providing a condition for high coexistence of species as well as high amount of niche overlap *i.e.*, sharing of resources among the coexisting species.

The Margalef diversity index varied considerably from 0.681 to 1.498. The higher diversity values so derived reflect the suitability of habitat for the organism in one hand while on the other the high species diversity has been reported to be correlated with longer food chain and complex food web of the ecosystem and also relatively more stable community (Margalef, 1986). Further the Margelef diversity index commonly varied between 1.0 to 5.0 and the larger the index a more healthy body of water. When it tends towards 1.0 pollution is though to increase and a damage should be suspected.

The "evenness component' of diversity" or "evenness" based on Shanon-Weaver diversity index is thought to denote a balanced relation between the species and individual richness of a sample. The evenness values were found ranging between 0.730 to 0.955. This data show that there is no significant variation in the evenness component of diversity as compared to the diversity itself.

On the basis of foregoing discussion it can be concluded that the habitat is moderately polluted but does not have any obvious stress as the community is stable with long food chain and complex food web. The resources in the habitat are diversified and an average species of the community has low diversity of utilization. The component of the community share the resource to a higher extent.

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