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Niche and Competitive Relationships Among Certain Freshwater Oligochaetes

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The present paper deals with the niche overlap among seven dominant freshwater oligochaetes apart with competitive relationships among them. Out of these species *Branchiura sowerbye* and *Dero* sp. are ecologically nearer to each other. The probable factors operating in niche overlapping are discussed.

Key words : Niche, Competition, Oligochaetes.

Introduction

Out of the three important approaches to the niche concept—the Grinellian (1917) or habitat niche concept, the Eltonian (1927) or functional niche concept, and the Hutchinson's (1957) or hypervolume multidimensional niche concept—the last one has been used to explain co-existence competition and competitive exclusion of species in a community. In Hutchinson's concept the n-dimensions are environmental parameters and the points in the fundamental niche correspond to the states of environment which would permit the species to exist indefinitely. Further in Hutchinson's (1957) definition the boundary of the fundamental niche is determined by the limiting states of all possibile ecological variables, both physical and biological, which allows the species to survive. The realized niche is a portion of fundamental niche within which the species is constrained by interaction with its competitors. Hence the overlapping of niche has been taken as an important tool to measure the interaction between individuals.

Mac-Arthur and Levins (1967), Mac-Arthur (1968) and Levins (1968) have further developed the multidimensional concept of Hutchinson for various manipulations and Mac-Arthur, (1960), Wittaker, (1965), Levins (1968) stressed that to assess how much the niches overlap is one of the three important and reliable methods to measure biological interaction under natural condition (Connell, 1975).

As no work has been done on niche

overlap among macrobenthic fauna in this sub-continent, the present communication provides some basic information in this regard.

Materials and Methods

Oligochaetes were sampled along with other macrobenthic fauna following standard methods described in detail elsewhere (Sinha *et al*, 1939). The oligochaetes were sorted out and preserved in the laboratory and their population density per square metre was calculated averaging five samples each consisting of seven replicates. All the samples were taken from the same habitat

Table –1. Species composition and period of minimum and maximum occurrence of oligochaetes.

Family/Taxon	Max. No./Month		Min. No./Abs/Month		% F.O.**
TUBIFICIDAE					
Branchiura sowerbyi	885	Aug. '86	89	Nov. '85	100.00
Branchiodrilus hortensis	178	Jul. '86	Abs.	in Dec. '85, May & Jun. '86	75.00
Tubifex tubifex	194	Jul. '86	Abs.	in Dec. '85 & Sep. '86	83.33
Auledrilus americanus	25	Jul. '86	Abs.	in all months	8.33
Limnodrilus udekemianus	233	Oct. '86	Abs.	in Jan , Mar, Apr. & Jun. '86	66.66
L. angustipenis	279	Jul. '86	Abs.	in Feb. & Sept. '86	83.33
L. claparedianus	177	Mar. '86	Abs.	in all months expt. Jun. & Jul. '86	16.66
L. hoffmeisteri	14	Mar. '86	Abs.	in all months expt. May & Jul. '86	25.00
AELOSOMATIDAE					
Aelosoma sp.	789	Jul. '86	Abs.	in Oct. 85	91.66
NAIDIDAE					
Chaetogaster sp.	130	Jul. '86	Abs.	in Nov. '85, Jan., Apr., & Sep. '86	58.33
Dero pectinata	140	Oct. '85	Abs.	in all months expt. Jan., May & Jul. '86	33.33
Dero sp.	352	Jul. 86	Abs.	in Oct. '85	91.66
Pristina sp.	29	Jan. '86	Abs.	in all months expt. Apr. & July '86	25.00
Bratislavia bilongata	08	Apr. '86	Abs.	in all months expt. in Jan. '86	16.66

**F.O.= Frequency of Occurrence in the year round samples.

but from different points and nearly at the same time.

The methods of Levins (1968), Hurlbert (1978) along with Pianka (1975) with some modifications were adopted to calculate the niche overlap values among the seven dominant species of oligochaetes. On the basis of average niche overlap in a pair of interspecific interaction [$\alpha x(y) \times \alpha y(x)$] as suggested by Levins (1968), an UPGMA dendrogram was drawn following Sneath and Sokal (1973) for five species only to show the extent of niche overlap.

Results and Discussion

A total of fourteen species of littoral freshwater oligochaete forms were encountered during the present investigation. The species composition, maxima and minima of population density per square metre along with percentage of frequency of occurrence have been presented in Table—1. Out of the fourteen species, seven dominant species namely *Branchiura sowerbye (B. sow.)*, *Limnodrilus udekemianus (L. ude.)*, *Dero* sp., *Aelosomo sp. (Aelo.* sp.), *Tubifex tubifex (T. tub.)*, *Dero pectinata (D. pec.)* and

Table—2 : Niche overlap between pairs of the seven dominant oligochaete species. A. Overlap of species of vertical column over those of horizontal column. B. Overlap of species of horizontal column over vertical column. (Species abbreviations similar as in the text.)

	B. sow.	*L. und.*	*Dero* sp.	*T. tub.*	*L. ang.*	*Aelo* sp.	*D. pec.*
	A.						
B. sow.		0.767	0.953	0.768	1.036	0.981	0.823
L.ude.			0.769	1.005	0.705	0.230	0.747
Dero sp.				0.733	1.032	1.030	1.029
T. tub.					0.766	0.571	0.757
L. ang.						0.834	0.900
Aelo. sp.							0.878
D. pec.							
	B.						
D. sow.							
L. ude	0.815						
Dero. sp.	0.980	0.744					
T. tub.	0.736	0.972	0.684				
L. ang.	0.754	0.483	0.731	0.581			
Aelo sp.	0.807	0.501	0.824	0.490	0.943		
D. pec.	0.708	0.605	0.861	0.679	1.064	0.917	

Limnodrilus angustipenis (*L. ang.*) were selected for niche overlap studies. Table—2 (A & B) embodies the data on niche overlap between various interspecific combinations among the above named seven species. Five species out of the above seven viz. *B. sowerbyi*, *Dero* sp., *Aelosoma* sp., *L. angustipenis* and *L. udekemianus* were included in dendrogram on account of their high percentage in frequency of occurrence.

The data obtained on niche overlap values (Table—2A & B) show that some of the species like *B. sowerbye* with *L. angustipenis*; *Dero* sp. with *L. angustipenis* ; *Aelosoma* sp. with *D. pectinata* ; *L. udekemianus* with *T. tubifex* reveal strong relationships through higher values of niche overlap. This relationship, as evident by the extent of overlapping of niche portions depicts indirectly the extent of competition among them since competition has been reported to occur wherever niches overlap even to a partial extent (Odum, 1957).

The dendrogram (Fig.—1) based on the average niche overlap in a pair of interspecific interaction clearly and reasonably points out that out of five species *B. sowerby* and *Dero* sp. are ecologically nearer to each other than rest three species Hence the dendrogram depicts the extent of ecological closeness among the species.

The realized niche is the part of fundamental niche which allows the various competitors to occur as this portion actually gets overlapped by similar niche portions of the competing species. The data obtained indicate that the species in which niche overlapping occurs are *L. ude.* over *T. tub.* (1.005) ; *B. sow.* over *L. ang.* (1.036) ; *Dero* sp. over *L. ang.* (1.032) (Table—2). But as the overlapping value for the same interacting pair may change under changed environmental conditions and population densities (Sinha *et al.*, 1993), the realized niche, therefore, can change rather quickly as a result of environmental change, population change and individual activity, while the fundamental

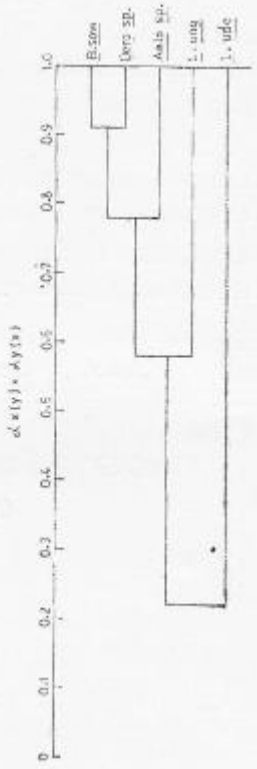

Fig. 1. A dendrogram showing the niche overlap between the most abundant five species of Oligochaetes taxa as $\alpha x(y) \times \alpha y(x)$ (Levin, 1968) Species order coded as text.

niche can not be modified but by natural selection (Connell, 1975).

The strength of relationship by the values of niche overlap specific for a pair of species as presented in Table—2 in opposite direction can be weak, that is higher the competitive strengh, lower the co-operative

coexistence of species in the community (Sinha *et al.*, 1991).

The values recorded on niche overlap between a set of species overlapping one on other and *vice versa* are not the same which suggest that two interacting species do not have equal pressure on each other viz. the overlap value of *B. sowerbye* over *L. udekeminaus* is as high as 1.036 showing complete coverage of realized niche while in reverse the value of overlap of *L. udekemianus* over *B. sowerbye* is merely 0.754. Similar are the interaction values for other pairs of species ranging between a minimum value of 0.483 (overlap of *L. angustipenis* over *L. udekemianus*) to a maximum value of 1.064 (overlap of *Dero* sp. over *L. angustipenis*). This type of uneven niche overlap between a pair of interacting species has been reported for other communities (Connell, 1975) and has been attributed usually to be density dependent, but not always apart from the factor influencing the resource availability.

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