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Studies on Niche Breadth of Aquatic Oligochaetes of Some Tropical Freshwater Bodies

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Abstract: The present paper dealt with the measurement of niche breadth of some dominant aquatic Oligochaetes and to ascertain whether they are habitat generalists or specialists. Of the total 11 Oligochaet species, 6 belong to Tubificidae, 1 belongs to Aeolosomatidae and the rests to Naididae. The overall highest value of niche breadth among all the spp. round the year was 4.975 in the month of December for *Branchiura sowerbyi* while the lowest value was 1.000 for many spp. except a few. Out of 11 Oligochaetes, 6 (*Branchiura sowerbyi,Tubifex tubifex, Limnodrilus udekemianus, Limnodrilus angustepenis, Aelosoma* sp. and *Dero* sp.) were grouped under habitat generalists whose average niche breadth values were 4.124, 3.212, 3.219, 3.654, 3.600 and 3.936 respectively. Only 1 Oligochaet i.e. *Aulodrilus americanus* (0.666) was categorized as habitat specialists. Remaining four viz. *Limnodrilus hoffmeisteri, Dero pectinata, Chaetogaster* sp. and *Pristina* sp. were categorized as habitat intermediates with mean values of 2.082, 1.959, 1.952 and 1.645 respectively.

Key words: Oligochaeta · Niche · Versatility and Macrofauna

INTRODUCTION

A positive interspecific relationship between local abundance and regional distribution has been documented in a variety of species assemblages over a spectrum of spatial scales, and it has been considered an almost universal pattern in ecology [1-7]. Of the several variables that may influence this relationship [8, 9], niche breadth and resource availability are among the most important ecological factors [2, 3, 5].

The concept of niche breadth underlies many hypotheses in evolutionary ecology. Niche breadth is defined as the degree of similarity between the frequency distribution of resources used by members of a population and the frequency distribution of resources available to them [10]. The physical environment, resources available and competitors are thought to affect the breadth of a population niche over ecological or evolutionary time spans [11-13]. If two populations have access to the same resource base, then the population whose numbers as a group tend to use resource in proportion to their availability has a broad niche relative to a population whose members as a group tend to concentrate on items in some resources states and to bypass items in others [14-16]. In terms of the spatial model, as formalized by Hutchinson [17] and expanded by Slobodkin [18], Levins [11] and Mac Arthur [19], niche breadth is the "distance through" a niche along some particular line in the niche space. Other terms have been used for niche breadth including "niche width" [20, 21], "niche size" [22, 23] and "versatility" [24]. In all these cases and here in the present study the property "niche breadth" referred to is essentially the inverse of ecological specialization, a term which has been used by Kohn [25] in qualitative sense. A similar sense of the term has been adopted by Dash and Mahanta [26]. They used the term niche breadth as the habitat niche breadth-which is the reality associated with the term, since it is distance in a niche space.

An attempt has been made to measure the niche breadth of some dominant aquatic oligochaetes sampled from different tropical freshwater bodies and to ascertain whether they are habitat generalists or specialists.

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MATERIALS AND METHODS

Freshwater aquatic Oligochaetes were sampled from four sampling habitats by means of Ekman's dredge (523Cm^2) [27]. Three dredging constituted a sample for macrofauna, which was sieved through metallic gauge (256 meshes / Cm^2). From the residual organisms Oligochaetes were sorted out and enumerated species wise and expressed as number per m^2. The average of the four samples was considered as the representative sample.

The identification of the organisms was done with the help of literature of Ward and Whipple [28], Needham and Needham [29], Brinkhurst [30] and some were identified at Zoological Survey of India (Calcutta). The niche breadth of different Oligochaet species was computed following the methods of Levins [11].

RESULTS AND DISCUSSION

Oligochaeta is an abundant group of benthic organisms [31]; this group is registered in almost all freshwater environments and is abundant in several environments [32-36]. In this study, a total of 8 genera and 11 species belonging to 3 families were identified including 6 species of Tubificidae, 1 sp. of Aeolosomatidae and 4 species of Naididae.

A considerable variation in niche breadth scores has been recorded in case of Oligochaet fauna (Table 1 and 2) during different months of the year. The value of niche breadth ranged from the minimum score of 1.511 for *Pristina* sp. to a maximum 4.784 for *Limnodrilus angustipenis* in January. In the following month maximum and minimum values of niche breadth were found to be lower than that of January i.e. 3.760 for *Dero* sp. and 1.000 for *Pristina* sp., while in March the lower value was the same as the previous month for the same species and the higher value was 4.543 for *Dero* sp. Maximum value between the range of 4.5 and 4.6 was recorded by *Dero* sp., *Branchiura sowerbyi* and *Tubifex tubifex* during April, May and June respectively. While the minimum value of niche breadth (1.000) was obtained for *Chaetogaster* sp., *Dero pectinata* and *Aulodrilus americanus* during this period. In the following month the lowest value of niche breadth was more than all the previous months exhibited by *Chaetogaster* sp. (1.929) and *Aulodrilus americanus* (1.997) while the highest value (4.340) was shown by *Limnodrilus udekemianus* followed by *Dero* sp. (4.273) and *Branchiura sowerbyi* (4.486). In August, the highest value were calculated to be more than four viz. 4.486 (*Tubifex tubifex*), 4.415 (*Limnodrilus augustipenis*), 4.405 (*Aelosoma* sp.), 4.129 (*Dero* sp.), while the minimum value was 1.000 for three species. *Branchiura sowerbyi* showed maximum

Table 1: Niche Breadth of different Oligochaet Spp. along 5 resources gradient during one year

S.No	Name of species	Jan	Feb	Mar	Apr.	May	June	July	Aug	Sep	Oct	Nov	Dec
1	*B. sowerbyi*	3.600	3.874	2.971	3.385	4.569	3.932	4.086	3.817	4.625	4.684	4.831	4.975
2	*L.hofmeisteri*	1.999	1.782	4.397	2.598	1.000	1.932	2.376	1.000	3.331	0.000	2.778	1.800
3	*T.tubifex*	2.700	2.336	3.101	3.595	4.471	4.601	3.917	4.486	3.433	1.000	3.914	1.000
4	*A.americanus*	0.000	0.000	0.000	0.000	1.000	1.000	1.997	1.000	1.000	0.000	0.000	0.000
5	*L.undekemianus*	3.023	2.841	2.807	3.257	3.538	2.073	4.340	2.957	4.011	3.461	3.151	3.169
6	*L.angustepenis*	4.784	1.983	4.247	3.604	3.654	4.136	2.973	4.415	3.878	2.749	3.327	4.107
7	*Aelosoma* sp.	3.108	2.139	2.711	4.322	4.092	3.482	3.361	4.405	4.300	3.462	4.772	3.049
8	*Dero pectinata*	2.336	1.000	1.997	1.000	2.317	1.000	3.513	2.981	2.336	2.000	1.418	1.613
9	*Chaetogaster* sp.	1.932	1.728	2.000	1.000	1.000	1.945	1.929	2.336	1.000	1.782	3.583	3.168
10	*Dero* sp.	3.776	3.760	4.543	4.625	3.260	4.373	4.273	4.129	3.617	3.406	3.583	3.901
11	*Pristina* sp.	1.511	1.000	1.000	2.814	1.269	1.800	2.667	1.000	2.919	0.000	1.835	1.932

Table 2: Statistical analysis for niche breadth of Oligochaet spp. during one year

S. No.	Name of species	Mean	S. D.	Variance	S. E.	Value at 95% CL
1	*Branchiura sowerbyi*	4.124	0.663	0.439	0.191	4.124±0.042
2	*Limnodrilus hoffmeisteri*	2.083	1.104	1.218	0.318	2.082±0.699
3	*Tubifex tubifex*	3.212	1.195	1.429	0.344	3.212±0.735
4	*Aulodrilus americanus*	0.666	0.666	0.443	0.192	0.666±0.422
5	*Limnodrilus udekemianus*	3.219	0.561	0.315	0.161	3.219±0.354
6	*Limnodrilus angustepenis*	3.654	0.757	0.573	0.218	3.654±0.479
7	*Aelosoma* sp.	3.600	0.754	0.569	0.217	3.600±0.477
8	*Dero pectinata*	1.959	0.766	0.587	0.221	1.959±0.486
9	*Chaetogaster* sp.	1.952	0.768	0.590	0.221	1.952±0.486
10	*Dero* sp.	3.936	0.429	0.184	0.123	3.936±0.272
11	*Pristina* sp.	1.645	0.830	0.689	0.239	1.645±0.526

S. D. = Standard deviation, S. E. = Standard error, CL = confidence limit

value of niche breadth more than 4.6 and less than 5 for the last four consecutive months. During this period, minimum value of 1.000 was observed for *Tubifex tubifex*, *Aulodrilus americanus* and *Chaetogaster* sp. except *Dero pectinata* whose value was 1.418. The overall highest value considering the scores of all the species, round the year of niche breadth was 4.975 in the month of December for *B. sowerbyi* while the lowest value of total was 1.000 for many Oligochaet spp.

As far the ranges of fluctuation in total niche breadth of individual species is concerned, the highest value was that of *Branchiura sowerbyi* showing lowest value in March and highest in December. The total niche breadth score for *Limnodrilus hoffmeisteri* was the minimum in the month of August while the maximum in the month of March. The average niche breadth value was 3.212 for *Tubifex tubifex*, the highest value being 4.601 in June and the lowest (1.000) in October and December. The lowest average niche breadth value of all the Oligochaet species was that of *Aulodrilus americanus* (0.666) while its highest value was 1.997 in July. *Limnodrilus udekemianus* was one of that Oligochaet spp. which got higher total niche breadth score round the year. The highest value was recorded in the month of July being and the lowest in the previous month. Similar to *Limnodrilus udekemianus; L. augustipenis* and *Aelosoma* sp. also showed high range of total niche breadth score (average value of 3.6) throughout the year. *Dero pectinata* the other member of the same family did not get higher total niche breadth scores. The average total niche breadth of *Chaetogaster* sp. was more or less the same as that of *Dero pectinata.* The highest and lowest niche breadth values were also same for both. *Dero* sp. showed comparatively higher value of total niche breadth ranking next to the highest scorer *B. sowerbyi*. The highest value of total niche breadth for *Dero* sp. was recorded in April while the lowest was in October, averaging to 3.936 ± 0.429. The average value of total niche breadth of *Pristina* sp. was 1.645 with maxima and minima as 1.000 and 2.184 which was recorded in August and April respectively.

A similar variability in niche breadth has been reported by McQueen [37]. Niche breadth of a species in general suggests independent species utilization of the environmental gradients responsible for supporting the species in the system [37]. The broadest niche breadth appears to be for the species which have wide tolerance limit. Further the variation in niche breadth is reflected due to interaction of species independently to n-dimension of niche (Sensu Hutchinson). Climatic change and habitual chemistry appear to be the most important limiting factor in niche breadth [38]. The similarity in niche breadth between species reflects identical way of utilization of habitat and similar way of interaction with environmental gradients. The species that utilize a broad spectrum of environment and are found in all the study sites i.e. in different ecological categories [15], have been found to have high niche breadth values in comparison to those species which are either not found in every habitat or in other words do not utilize so broad spectrum of resources. The species that utilize a broad spectrum of environment and are found in all the study sites were considered as habitat generalists since the present scores of niche breadth, refers to the habitat niche breadth [23]. These species usually have high niche breadth. Species with restricted distribution and appearing to survive in a narrow range of environmental spectrum in juxtaposition to the situation presented by above mentioned species have lower niche breadth and are considered as habitat specialists. All other species with niche scores in between the two extremes-the habitat generalists and habitat specialists are considered as habitat intermediates.

The niche breadth scores taken for explanation in the present study are the total niche breadth values-a sum of five values from resource gradients for the organisms considered. On the basis of niche breadth value from all resource gradients the three categories of species were divided. Species having mean niche breadth scores more than three were grouped under habitat generalists (*Branchiura sowerbyi, Tubifex tubifex, Limnodrilus udekemianus, Limnodrilus angustepenis, Aelosoma* sp. and *Dero* sp.), species having scores less than one were grouped as habitat specialists which was *Aulodrilus americanus,* and the species with niche breadth score between one of three were the intermediary species (*Limnodrilus hoffmeisteri, Dero pectinata, Chaetogaster sp.* and *Pristina sp.*) (Table, 2).

The niche breadth signifies the versatility of the species. A species with higher niche breadth is more versatile than one which has smaller niche breadth. Higher niche breadths species have higher tolerance limit to environmental variables hence are generally cosmopolitan in distribution while low niche breadth species show restricted distribution. The niche breadth may be taken as one of the measure of priority fixation of the species concerned from conservation view point.

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