OBSERVATIONS ON THE COLONIZATION OF GRADED SANDS BY THE INTERSTITIAL FAUNA OF THE SOUTH-WEST COAST OF INDIA

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This paper presents the results of the experiments conducted on the colonization of the interstitial fauna in the depopulated graded sands, at four stations during different periods of the year, namely, the pre-monsoon, the monsoon and the post-monsoon. Preferences of the important groups of animals with reference to different grades of sand were noticed, together with a detailed study of the preferences of different species of nematodes, gastrotrichs and archiannelids. A definite correlation between the grain size and the number and size of the organisms could be noticed during these tests.

INTRODUCTION

Preliminary observations made at four stations along the south-west coast of India (Figs. 1–2) have indicated the existence of a correlation between the grain size and the incidence of particular species of the interstitial fauna (Govindankutty and Nair 1966). That the texture of the substratum exerts a profound influence on the distribution of the sand microfauna has already been observed by Davis (1925), Prenaut (1932, 1960), Fraser (1935) and Jones (1950). Detailed ecological investigations made during the last decade by Pennak (1950) Wieser (1956, 1959), Renaud-Debyser (1958, 1963), Delamare-Deboutteville (1953, 1960), Boaden (1962), Swedmark (1964), Wallace (1958, 1959), Jansson (1966, 1967 *a*, *b*, 1968) Ganapati and Rao (1962), Rao and Ganapati (1968), and others showed that the size of the sand grains has constant relationship to both the number and the pattern of distribution of the organisms inhabiting the interstitial habitat. Investigations of Wieser (1956, 1959) and Jansson (1967 *a, b*) showed that even slight changes in the shape and texture of the substratum may prove to be of utmost importance in the composition of the populations inhabiting a particular locality. Delamare-Deboutteville (1953) noticed that the occurrence of mystacocarid *Derocheilocaris remanei* Delamare and Chauppuis is dependent on the sand with a medium diameter of about 200 μ. Renaud-Debyser (1958) demonstrated the colonization of the depopulated sand of the beach of Arcachon. Boaden (1962) investigated the colonization of the graded sand by the interstitial fauna on the North Wales beaches and noted the preferences of the particular species to definite grades of sand. Jansson (1967 *a, b*) studied the significance of grain size and pore-water content for the interstitial fauna of the sandy beaches of the Baltic Sea and the Swedish west coast. No detailed attempt has hitherto been made to study the preferences of different species to definite grades of sand and the pattern of their distribution from the tropical sandy beaches. With a view to studying the pattern of distribution of the interstitial fauna with reference to their preferences, if any, to definite grades of sand and

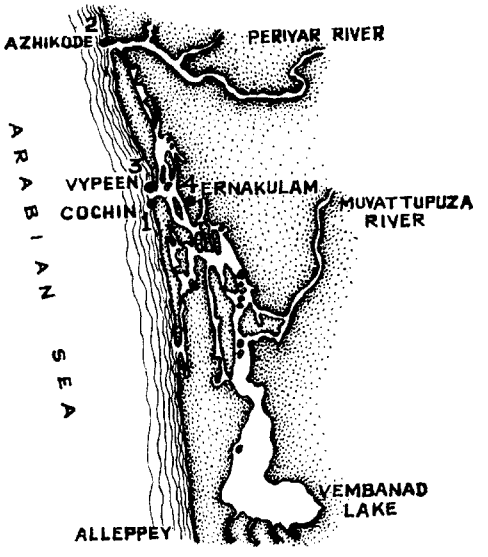

Fig. 1

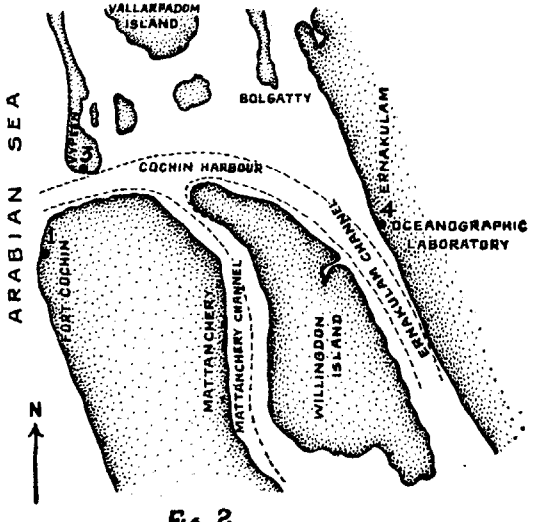

Fig. 2

FIGS. 1–2. 1, map of the south-west coast of India showing the four stations (I, II, III & IV) investigated ; 2, map of the Cochin harbour indicating the positions of stations I, III and IV.

to know how far grain size can act as a distribution barrier in this habitat, a set of experiments were conducted, the results of which form the subject of this communication.

MATERIALS AND METHODS

A large quantity of sand was collected from the beach, dried and sorted out into seven fractions having diameters of approximately 700, 550–700, 420–550,

310–420, 250–310, 160–250, 90–160 μ. Nine glass tubes, each having a diameter of 4 cm and a volume of 275 cc, were taken and seven of these tubes filled with the above grades of sand. Of the remaining two, one was packed with the dried but unsorted sand and the other with fresh sand from the beach. All tubes, open at both ends, were buried horizontally in a row at about the mid tide level on the beach side by side at a depth of about 15 cm from the surface. After a period of 30 days all tubes were carefully removed and taken to the laboratory. A small portion of the sand from both ends of the tubes was rejected to avoid any possible mixing of the sorted sand with the beach sand. The tubes were then emptied and the animals separated from the sand. Later, they were sorted into groups, identified as far as possible and their numbers counted. These experiments were conducted at all the four stations during the pre-monsoon, the monsoon and the post-monsoon period.

OBSERVATIONS

Tables I–V show results of the experiments conducted at the four stations during the three periods of the year, namely, the pre-monsoon, the monsoon and the post-monsoon. In Table I the number of animals of the different groups, in Tables II–IV the number of different species of nematodes and in Table V the number of different species of gastrotrichs and archiannelids sorted out from each tube are presented.

From Table I the reactions of particular groups of organisms towards grain size can be noted. Though there were variations in the number of animals recovered from each tube buried at stations I–IV, an identitical trend in their general preferences towards particular grain size was evident at all stations and during all the periods, namely the pre-monsoon, the monsoon and the post-monsoon. Another point of interest was the presence of greater numbers of animals in fresh beach sand than either in the dried unsorted sand or in the graded series of sand in all the tests.

In general, a reduction in the total number of animals corresponding to a decrease in grain size could be noticed at all stations. A closer scrutiny of the results showed that ciliates apparently had a greater preference to sand grains ranging from 420–700 μ. Foraminifera also preferred sand grains ranging from 420–700 μ, while turbellarians, isopods and archiannelids were found to appear mostly in grades between 550–700 μ and above. Isopods were absent in grades finer than 550 μ, while gastrotrichs and archiannelids were rare below that grade and totally absent in grades finer than 250 μ. Turbellarians showed a noticeable fall in number in grades smaller than 420 μ. Though copepods and nematodes occurred in fair numbers in all grades of sand, a distinct preference was discernible in grades ranging from 500–700 μ and above. Polychaetes did not appear in any of the grades during the pre-monsoon and the post-monsoon periods at stations I and II. However, they appeared in medium sands (250–500 μ) at stations III and IV during the pre-monsoon period. At stations I and II they were abundant during the monsoon period and showed a definite preference to grades ranging from 400–700 μ and above. Their number in grades finer than 420 μ was very low or even a nil.

The results of the observations on the colonization of the different species of nematodes are given in Tables II—IV. The composition of the nematode fauna

showed variations during different seasons of the year and at different stations. The environmental conditions of the stations and their seasonal fluctuations did not apparently affect the reactions of the species in relation to grain size. However, these tests conducted during the three periods of the year facilitated a study of all the common species occurring in this area.

During the pre-monsoon period 17 and 15 species of nematodes appeared in fair numbers in the experimental tubes exposed at stations I and II respectively. Of these *Anticoma quadriseta, Desmodora inflexa, Chromadora indica, Thoracostoma amphidota, Dolicholaimus acutus* and *Cyatholaimus ocellatus* showed a preference to sand grains ranging from 160–500 μ in size. Of these, except *D. inflexa, T. amphidota* and *C. ocellatus*, all others showed a decline in their numbers in grades finer than 250 μ. A reduction in their numbers was evident in coarse grains also. Species like *Spirina tenuicauda, Sphaerolaimus campbelli, Oncholaimus flexus, Synodontium fecundum, Paracanthonchus hawaiiensis, Cyatholaimus gracilis, Bathylaimus assimilis, Dolicholaimus benepapillosus, Pterygonema ornatum, Theristus parabutschli* and *Steineria cobbi* were found in greater numbers in coarse grains ranging in size from 500–700 μ and above. Their number showed reduction in grades finer than 420 μ and were totally absent in grades lower than 160 μ.

During the pre-monsoon period only seven and four species could be recovered from the tubes exposed at stations III and IV respectively. Of these *Anticoma quadriseta, Desmodora inflexa, Chromadora indica, Cyatholaimus ocellatus* and *Pterygonema ornatum* have already been noticed at stations I and II and their reaction was just the same as noticed at those stations. *Metachromadora onyxoides, Rhabditis marina* and *Enoploides labiatus* appeared at station IV and a preference to grades ranging from 300 μ to 700 μ was noticed in them. However, *Thoracostoma trichodes* and *Theristus modicus* appeaing at station III did not show any noticeable preference to the different grades of sand.

The number and composition of the animals during the monsoon period was noticeably different from those of the pre-monsoon period. Altogether only seven species appeared during this test at stations I and II. *Anticoma quadriseta, Steineria cobbi* and *Sphaerolaimus campbelli* showed the same trend in colonization as was observed during the pre-monsoon period. *Oncholaimus notoviridis, Enoploides labiatus* and *Epacanthion microdentatus* occurred chiefly in grades ranging from 420-700 μ, while *Thoracostoma trichodes* was found to prefer grades between 250–500 μ. During the monsoon period only three species appeared at station III while at station IV only two species could be collected. All except *Theristus alternus*, were present during the pre-monsoon period and their reaction towards grain size was just similar. *T. alternus* showed a preference to grades ranging from 160–550 μ.

During the post-monsoon period five more species, viz. *Oncholaimus brachycercus, Mesacanthion ungulatus, Cynura papillata, Rhynchonema hirsuta* and *Triconema* sp. made their appearance in tubes at stations I and II, and all of them, except *Rhynchonema hirsuta*, showed a distinct preference to coarse grains (550–700 μ and above). *O. brachycercus, M. ungulatus* and *Tricoma* sp. did not occur in grades finer than 500 μ. At station III the species of nematodes that appeared during the post-monsoon period were the same as those recorded during the other periods and there was not much difference in the nature of their incidence. However, at

TABLE I

Results of the experiments on the colonization of the graded sand by the different groups at stations I, II, III and IV *during the pre-monsoon, monsoon and the post-monsoon periods*

		Ciliata				Foraminifera				Turbellaria				Nematoda				Polychaeta				Archiannelida				Copepoda				Isopoda				Gastrotricha			
		St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV	St I	St II	St III	St IV
Dried	Pre-monsoon	21	18	11	11	16	11	7	5	4	6	0	0	44	42	17	10	0	0	2	2	1	1	0	0	42	41	11	2	0	1	0	0	2	2	0	0
beach	Monsoon	10	11	3	8	16	11	2	1	0	0	0	0	13	14	2	2	10	12	0	0	4	5	0	0	11	12	0	1	0	0	0	0	1	0	0	0
sand	Post-monsoon	20	12	9	9	19	12	8	2	8	9	0	0	32	36	13	6	0	0	0	0	2	3	0	0	23	29	3	3	1	2	0	0	2	3	0	0
	Pre-monsoon	18	7	12	6	13	12	9	6	12	15	0	0	48	45	4	6	0	0	1	0	2	3	0	0	53	52	10	0	0	0	0	0	4	5	0	0
700	Monsoon	4	10	0	1	18	12	4	0	2	3	0	0	11	11	2	0	10	10	0	0	5	5	0	0	31	23	0	0	1	1	0	0	0	0	0	0
	Post-monsoon	16	18	10	2	14	14	9	2	11	12	0	0	32	52	4	0	0	0	0	0	4	2	0	0	32	32	4	0	2	0	0	0	6	5	0	0
550–700	Pre-monsoon	20	12	12	4	14	16	7	6	11	11	0	0	42	43	7	4	0	0	2	1	1	1	0	0	35	40	9	0	0	1	0	0	2	3	0	0
	Monsoon	2	9	4	1	12	16	4	1	4	2	0	0	11	13	1	1	15	16	0	0	5	4	0	0	22	26	1	1	1	0	0	0	0	2	0	0
	Post-monsoon	11	13	12	5	20	21	11	5	12	14	0	0	12	46	4	1	0	0	0	0	2	1	0	0	34	18	0	1	0	0	0	0	4	5	0	0
420–550	Pre-monsoon	21	9	11	9	17	10	6	3	10	5	0	0	35	35	6	5	0	0	0	0	1	0	0	0	45	32	6	0	0	0	0	0	0	1	0	0
	Monsoon	8	16	4	5	10	12	8	3	1	0	0	0	12	11	1	1	8	9	0	0	4	4	0	0	21	30	0	0	0	0	0	0	1	1	0	0
	Post-monsoon	18	9	11	8	14	15	9	3	5	3	0	0	23	30	3	1	0	0	0	0	0	2	0	0	28	22	0	2	0	0	0	0	2	3	0	0
310–420	Pre-monsoon	16	16	9	11	11	6	11	4	1	0	0	0	28	32	15	7	0	0	0	2	1	0	0	0	37	21	15	1	0	0	0	0	0	0	0	0
	Monsoon	3	8	0	0	7	7	4	2	3	4	0	0	6	3	1	1	3	4	0	0	2	2	0	0	20	22	1	2	0	0	0	0	0	1	0	0
	Post-monsoon	11	4	2	3	13	9	9	1	4	5	0	0	28	23	11	9	0	0	0	0	0	1	0	0	29	19	2	2	0	0	0	0	0	2	0	0
250–310	Pre-moonsoon	17	8	0	0	14	7	10	6	2	1	0	0	25	25	13	11	0	0	0	2	0	0	0	0	25	18	13	2	0	0	0	0	0	0	0	0
	Monsoon	5	6	0	0	6	1	1	1	0	0	0	0	4	5	1	2	3	0	0	0	1	1	0	0	10	11	0	0	0	0	0	0	0	0	0	0
	Post-monsoon	7	10	8	4	12	13	20	0	1	2	0	0	16	22	10	4	0	0	0	0	0	0	0	0	21	23	1	1	0	0	0	0	0	0	0	0
160–250	Pre-monsoon	20	17	8	4	9	5	6	5	1	2	0	0	16	26	12	6	0	0	0	0	0	0	0	0	21	22	12	3	0	0	0	0	0	0	0	0
	Monsoon	10	3	0	0	2	2	1	3	0	0	0	0	4	5	1	2	0	0	0	0	0	0	0	0	8	9	0	0	0	0	0	0	0	0	0	0
	Post-monsoon	15	6	5	5	14	18	20	5	0	1	0	0	11	8	10	2	0	0	0	0	0	1	0	0	20	16	0	0	0	0	0	0	0	0	0	0
90–160	Pre-monsoon	4	8	2	2	6	4	4	2	1	1	0	0	13	16	8	4	0	0	0	0	0	0	0	0	18	19	10	0	0	0	0	0	0	0	0	0
	Monsoon	18	9	8	4	12	10	1	2	0	0	0	0	3	3	2	1	0	0	0	0	0	0	0	0	13	11	0	0	0	0	0	0	0	0	0	0
	Post-monsoon	23	21	10	8	19	15	9	10	0	1	0	0	3	9	8	2	0	0	0	0	0	0	0	0	9	7	2	2	0	0	0	0	0	0	0	0
Fresh	Pre-monsoon	6	3	2	3	12	13	4	3	15	14	0	0	40	45	16	13	0	0	1	2	1	2	0	0	55	53	12	3	0	0	0	0	5	4	0	0
beach	Monsoon	4	8	3	1	5	12	4	4	0	0	0	0	14	15	2	2	6	8	0	0	5	4	0	0	12	10	0	0	0	0	0	0	1	1	0	0
sand	Post-monsoon	22	15	12	10	30	14	11	4	9	12	0	0	23	41	12	8	0	0	0	0	1	2	0	0	31	30	5	4	0	2	0	0	3	2	0	0

TABLE II

The number of different species of nematodes colonising the respective grades of sand at the different stations during the pre-monsoon period

Name of species	Grade of sand	Dried sand				700				550–700				420–550				310–420				250–310				160–250				90–160				Fresh beach sand			
	Stations	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Anticoma quadriseta	..	6	5	3	–	3	3	0	0	2	2	0	–	5	4	0	–	8	8	2	–	5	6	3	–	4	3	3	–	2	2	2	–	5	6	3	–
Desmodora inflexa	..	1	3	2	–	0	0	0	–	2	2	0	–	5	6	2	–	6	6	2	–	3	4	1	–	2	3	2	–	3	4	2	–	1	4	0	–
Chromodora indica	..	2	2	3	6	1	2	0	0	0	0	0	0	1	1	1	0	2	0	3	1	2	2	3	7	1	3	1	2	1	1	2	2	0	0	2	5
Metachromadora onyxoides	..	–	–	–	2	–	–	–	1	–	–	–	1	–	–	–	2	–	–	–	5	–	–	–	2	–	–	–	3	–	–	–	2	–	–	–	4
Spirina tanuicauda	..	6	7	–	–	5	4	–	–	9	8	–	–	3	4	–	–	2	2	–	–	1	1	–	–	1	2	–	–	0	1	–	–	3	8	–	–
Theristero alternus	..	3	–	–	–	6	–	–	–	2	–	–	–	1	–	–	–	0	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	4	0	–	–
Theristus modicus	..	–	–	2	–	–	–	2	–	–	–	2	–	–	–	0	–	–	–	2	–	–	–	1	–	–	–	2	–	–	–	0	–	–	–	5	–
Sphaerolaimus campbelli	..	2	1	–	–	2	3	–	–	2	5	–	–	0	3	–	–	0	2	–	–	0	1	–	–	0	1	–	–	0	0	–	–	3	0	–	–
Oncholaimus flexus	..	3	3	–	–	4	4	–	–	2	3	–	–	1	1	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	5	2	–	–
Thoracostoma amphidota	..	2	2	–	–	0	0	–	–	2	1	–	–	2	0	–	–	3	5	–	–	4	3	–	–	2	4	–	–	3	3	–	–	0	4	–	–
Thoracostoma trichodes	..	–	–	5	–	–	–	0	–	–	–	2	–	–	–	0	–	–	–	2	–	–	–	3	–	–	–	2	–	–	–	1	–	–	–	6	–
Synodontium fecundum	..	2	1	–	–	2	1	–	–	2	2	–	–	0	1	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	1	0	–	–
Paracanthonchus hawaiiensis	..	3	3	–	–	7	8	–	–	3	7	–	–	2	4	–	–	1	3	–	–	1	1	–	–	0	0	–	–	0	0	–	–	5	3	–	–
Dolicholaimes acutus	..	0	4	–	–	0	2	–	–	0	0	–	–	0	0	–	–	1	1	–	–	1	2	–	–	0	3	–	–	0	0	–	–	0	5	–	–
Dolicholaimus benipapillosus	..	–	3	–	–	–	6	–	–	–	4	–	–	–	3	–	–	–	2	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	6	–	–
Cyatholaimus gracilis	..	4	–	–	–	4	–	–	–	4	–	–	–	2	–	–	–	1	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	6	–	–	–
Cyatholaimus ocellatus	..	0	0	0	–	0	2	0	–	0	1	0	–	2	0	1	–	2	1	4	–	5	3	2	–	5	6	2	–	4	5	1	–	0	1	0	–
Bathylaimus assimilus	..	2	2	–	–	4	1	–	–	3	2	–	–	3	2	–	–	1	0	–	–	0	0	–	–	0	0	–	–	4	0	–	–	5	0	–	–
Pterogonema ornatum	..	0	1	2	–	2	3	2	–	3	2	3	–	3	3	2	–	0	0	0	–	0	0	0	–	0	0	0	–	0	0	0	–	1	2	0	–
Steineria cobbi	..	5	–	–	–	7	–	–	–	2	–	–	–	2	–	–	–	0	–	–	–	1	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–
Theristus parabutschli	..	3	5	–	–	1	6	–	–	4	4	–	–	3	3	–	–	1	2	–	–	0	1	–	–	0	1	–	–	0	0	–	–	1	4	–	–
Rhabolitis marina	..	–	–	–	2	–	–	–	3	–	–	–	2	–	–	–	2	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	0	–	–	–	3
Enoploides labiatus	..	–	–	–	0	–	–	–	2	–	–	–	1	–	–	–	1	–	–	–	0	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	1

TABLE III

The number of different species of nematodes colonising the respective grades of sand at the different stations during the monsoon period

Name of species	Grade of sand	Dried sand				700				550–700				420–550				310–420				250–310				160–250				90–160				Fresh beach sand			
	Stations	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Anticoma quadriseta	..	3	1	0	–	0	0	0	–	1	1	0	–	0	0	0	–	2	0	0	–	2	1	0	–	1	1	0	–	1	2	1	–	0	3	1	–
Thoracostoma trichodes	..	2	3	–	–	0	0	–	–	1	1	–	–	1	2	–	–	1	0	–	–	0	1	–	–	0	1	–	–	1	0	–	–	0	2	–	–
Oncholaimus notovividis	..	1	2	–	–	0	2	–	–	1	1	–	–	1	1	–	–	0	0	–	–	0	1	–	–	0	0	–	–	1	0	–	–	1	1	–	–
Enoploides labiatus	..	4	–	–	–	4	–	–	–	3	–	–	–	4	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	5	–	–	–
Epacanthion microdentatus	..	1	1	–	–	3	3	–	–	4	5	–	–	4	1	–	–	1	0	–	–	1	1	–	–	3	2	–	–	0	0	–	–	6	3	–	–
Steineria cobbi	..	1	1	–	–	2	0	–	–	1	1	–	–	2	1	–	–	1	0	–	–	1	0	–	–	0	0	–	–	0	0	–	–	1	2	–	–
Sphaerolaimus campbelli	..	1	–	–	–	2	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	0	–	–	0	0	–	–	1	–	–	–
Theristus alternus	..	–	–	1	–	–	–	0	–	–	–	0	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–
Rhabditis marina	..	–	–	1	–	–	–	2	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–
Metachromadora onyxoides	..	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	1	–	–	–	2
Chromadora indica	..	–	–	–	2	–	–	–	0	–	–	–	1	–	–	–	0	–	–	–	0	–	–	–	1	–	–	–	1	–	–	–	0	–	–	–	0
Enoploides labiatus	..	–	5	–	–	–	6	–	–	–	3	–	–	–	5	–	–	–	3			–	1	–	–	–	1	–	–	–	1		–	–	3	–	–

TABLE IV

The number of different species of nematodes colonising the respective grades of sand at the different stations during the post-monsoon period

Name of species	Grade of sand	Dried sand				700				550–700				420–550				310–420				250–310				160–250				90–160				Fresh beach sand			
	Stations	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Anticoma quadriseta	..	10	8	2	–	1	0	0	–	0	5	0	–	3	11	0	–	9	12	4	–	6	7	2	–	1	3	1	–	0	3	0	–	2	6	2	–
Thoracostoma trichodes	..	0	7	5	–	2	6	1	–	1	2	0	–	3	3	0	–	11	2	2	–	0	0	3	–	7	5	4	–	1	2	0	–	5	8	4	–
Oncholaimus brachycercus	..	5	1	–	–	0	2	–	–	1	1	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	3	0	–	–
Mesacanthion ungulatus	..	0	0	–	–	5	7	–	–	0	8	–	–	2	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	3	–	–
Epacanthion microdentatus	..	8	0	–	–	2	11	–	–	1	7	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	1	5	–	–
Rhynchonema hirsuta	..	6	9	–	–	1	9	–	–	0	8	–	–	5	5	–	–	0	4	–	–	0	3	–	–	0	0	–	–	0	2	–	–	2	0	–	–
Desmodora inflexa	..	0	10	1	–	0	0	0	–	7	0	0	–	9	9	0	–	5	5	1	–	10	11	1	–	2	0	0	–	2	2	0	–	0	3	1	–
Theristus modicus	..	0	1	–	–	8	0	–	–	0	3	–	–	0	2	–	–	1	0	–	–	0	0	–	–	2	0	–	–	0	0	–	–	1	0	–	–
Theristus alternus	..	0	–	0	–	4	–	0	–	0	–	1	–	1	–	2	–	2	–	0	–	0	–	0	–	0	–	0	–	0	–	0	–	3	–	1	–
Steineria cobbi	..	1	0	–	–	1	7	–	–	0	2	–	–	0	0	–	–	0	0	–	–	0	1	–	–	1	0	–	–	0	0	–	–	2	5	–	–
Sphaerolaimus campbelli	..	1	0	–	–	1	8	–	–	0	5	–	–	–	0	1	–	0	0	–	–	0	0	–	–	0	0	–	–	0	0	–	–	2	6	–	–
Spirina tenuicauda	..	–	–	2	–	–	–	2	–	–	–	3	–	–	–	0	0	–	–	2	–	–	–	2	–	–	–	3	–	–	–	4	–	–	–	2	–
Chromadora indica	..	–	–	3	3	–	'	1	0	–	–	0	0	–	–	–	0	–	–	2	2	–	–	2	0	–	–	2	0	–	–	4	0	–	–	2	2
Sabateria alyssalis	..	–	–	–	1	'	–	–	0	–	–	–	1	–	–	–	1	–	–	–	5	–	–	–	2	–	–	–	0	–	–	–	1	–	–	–	6
Metachromadora offilatus	..	–	–	–	2	–	–	–	0	–	–	–	0	–	–	–	–	–	–	–	2	–	–	–	2	–	–	–	2	–	–	–	1	–	–	–	0
Cynura papillata	..	–	0	–	–	–	0	–	–	–	5	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	2	–	–
Tricoma sp.	..	–	0	–	–	–	2	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	0	–	–	–	3	–	–

TABLE V

The number of different species of archiannelids and gastrotrichs colonizing the respective grades of sand at stations I and II during the different periods

Name of species	Dried sand		700		550–700		420–550		310–420		250–310		160–250		90–160		Fresh beach sand	
	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II	St I	St II
Pre-monsoon																		
Archiannelida																		
Saccocirrus sp.	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1
Protodrilus sp.	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1
Polygordius sp.	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastrotricha																		
Pseudostomella roscovita	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Paradasys remanei	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Macrodasys caudatus	1	2	1	3	1	1	0	1	0	0	0	0	0	0	0	0	2	2
Tetranchyroderma suecica	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macrodasys indicus	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0
Monsoon																		
Saccocirrus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protodrilus sp.	3	3	3	4	3	3	3	2	2	1	1	1	0	0	0	0	3	2
Polygordius sp.	1	2	2	1	2	1	1	2	0	1	0	0	0	0	0	0	2	2
Pseudostomella roscovita	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1
Paradasya remanei	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0
Post-monsoon																		
Saccocirrus sp.	0	2	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0
Polygordius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Protodrilus sp.	2	1	4	1	2	0	0	0	0	0	0	0	0	0	0	0	1	1
Pseudostonella roscovita	2	2	3	3	2	3	1	1	0	0	0	0	0	0	0	0	0	0
Macrodasys indicus	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Paradasys remanei	0	1	3	2	2	2	1	2	0	0	0	0	0	0	0	0	3	2

station IV, three species, namely, *Chromadora indica, Metachromadora effilatus* and *Sabacteria abyssalis* entered the tubes. Of these, *C. indica* showed the same trend as before while the other two species preferred medium to fine grades (90–420 μ).

The nature of colonization of five species of gastrotrichs and three species of archiannelids was also examined during this experiment. A preponderance of both these groups was noted in coarse sands ranging in size from 500–700 μ. Among gastrotrichs, except *Macrodasys indicus,* all others, namely, *Pseudostomella roscovita, Paradasys remanei, Macrodasys caudatus* and *Tetranchyroderma suecica* were conspicuous by their absence in grades finer than 420 μ. Archiannelids such as *Polygordius* sp., *Protodrilus* sp. and *Saccocirrus* sp. preferred grades between 310–700 μ and their maximum occurrence was noticed in grades between 550–700 μ.

Discussion

According to Wieser (1959) "the intertidal distribution of at least some of the more common species is not so much determined by levels of tidal water as by the pattern of distribution of certain grades of substrate." This is as it should be, since the grade of sand determines the diamensions of the pore spaces, the drainage conditions of the beach, rate of evaporation and the rate of capillary ascent of water-factors, all of which have either direct or indirect effect on the fauna inhabiting this specialised habitat (Swedmark 1964; Bruce 1928; Jansson 1966, 1967, 1968; Renaud-Debyser 1963; Govindankutty and Nair 1966). The faunistic composition of a specific locality is dependent on the characteristics of the substratum, and this is particularly so in the interstitial habitat where texture of the substratum or the grain size may even act as a distribution barrier (Swedmark 1964).

The above experiments facilitated an understanding of the preferences of the different groups and species occurring during different periods of the year towards the grades of sand. This relationship between the grain size and the nature of distribution of animals in this habitat suggests the over-riding influence of this factor in the ecology of these organisms.

Further, a definite correlation between the grain size and the number of organisms represented in this habitat was clearly evident. A comparison of the number of animals collected during a specific period from these stations revealed that there was marked reduction in the number of organisms from station II to station IV through stations I and III (Govindankutty and Nair 1966). Since the percentage of coarse grains was highest at station II and lowest at station IV these observations indicate the relationship between the number of organisms and the grade of the sand. This fact was clear from the experimental studies also, thereby, confirming the results obtained during the monthly collections from these stations.

A correlation between the body size of the interstitial organisms and the grain size can also be noticed. Wieser (1956, 1959) has investigated this aspect in detail. Braden (1962) in his studies on the colonization of the graded sand by the interstitial fauna of the North Wales beaches has also noticed this relationship. While studying the interstitial fauna of the Waltair coast, Chandrasekhara Rao and Ganapati (1968) found that there was a decrease in grain size from low water level to high water level and a majority of the larger and predatory forms occurred in coarse sands near low

water level. This is quite natural since the interstices in fine sand are too small for the accommodation of the larger forms. In the present series of tests also animals with comparatively larger bodies (Polychaetes, archiannelids, some species of turbellarians and nematodes, etc.) were seen in greater numbers in coarse grains. Again, forms which have long bodies and elongated palps and parapodia or conspicuous setations were found to appear only in sands of large grain size. Polychaetes, archiannelids like *Polygordius* sp., *Protodrilus* sp., and nematodes like *Sphaerolaimus campbelli, Epacanthion microdentatus, Mesacanthion ungulatus, Oncholaimus flexus*, etc. (comparatively large or with conspicuous setations) were collected from the coarse grains. Similarly small animals like certain species of copepods, nematodes and turbellarians showed a preference for finer grades. However, exceptions may also be seen in the case of ciliates, gastrotrichs and nematodes such as *Synodontium fecundum, Dolicholaimus benepapillosa, Rhynchonema hirsuta, Tricoma* sp., etc., which despite their small size occurred in fair abundance in large grains as well. Similarly certain species of archiannelids, turbellarians and nematodes like *Anticoma quadriseta, Thoracostoma amphidota, Cyatholaimus ocellatus*, etc., though large in size occurred in fair numbers in fine to medium sand. These disparities need not be taken too seriously, since grain size is not the only factor that determines the distribution of organisms on a sandy beach. (Jansson 1967, 1968). The influence of factors like temperature, salinity, oxygen content, availability of required type of food materials, etc. sholuld also be given due consideration while arriving at conclusions regarding the distribution of the representatives of the mesopsammon.

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