

Macrofauna & Meiofauna of Two Sandy Beaches at Mombasa, Kenya

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Macrofauna and meiofauna of 2 sandy beaches having medium and fine sand particles, respectively, were investigated, quantitatively. Macrofauna density was highest around high water mark and progressively decreased towards low water mark. Meiofauna density was maximum around high water mark at the English point, a more sheltered beach. On the more exposed Nyali Beach the meiofauna was aggregated downshore and highest numbers were recorded between mid and low water mark. On both the beaches the meiofauna was dominated by nematodes followed by harpacticoids.

Sandy beaches provide an environment of high stress and continued change for intertidal marine organisms. As a result, diverse, sometimes impoverished fauna inhabits this region¹. There are few surveys of beaches for both the macrofauna and meiofauna²⁻⁵. In the present study quantitative data on the macro and meiofauna, collected from two beaches at Mombasa (Kenya) are reported.

During the visit of *ORV Sagar Kanya* to Mombasa (Aug. 1983), 2 beaches (Fig. 1) namely English point and Nyali Beach, were sampled. Quantitative data on macrofauna were collected with the help of a quadrant (0.0625 m² area; penetration up to 15 cm) at 10 m intervals down the beach from a fixed point at high water mark (HWM) to the water's edge or low water mark (LWM). All samples were collected during low tide when maximum intertidal exposure prevailed. Each sample was sieved (0.5 mm mesh) in the surf water and the animals retained were counted and their total wet weight determined. For the collection of meiofauna samples, a plexiglass core (4 cm inner diam., 10 cm length) was used. Meiofauna were collected at all points from where macrofauna were sampled. The core sample was preserved in 5% formalin with Rose Bengal and analysed in the laboratory following the methods described elsewhere⁶.

At all tidal levels, temperature of the sediment was taken with the help of an ordinary thermometer

($\pm 0.1^\circ\text{C}$ accuracy) and sediment particle size analysis was done following the method of Morgans⁷.

Sediment characteristics—Table 1 summarizes the substrate data for the 2 beaches. It is seen that at English Point except for the HWM (0 m) all of the median particle diameters (Md) fall in the range of medium sand (0.5 - 0.25 mm). At Nyali beach, the sediments at all tidal levels have median particle diameter in the range of fine sand (0.25 - 0.125 mm). On both beaches there was a tendency for the finer sand to occur near HWM (0 m), and the coarser sand towards LWM (30 m). Similar pattern of sediment distribution has been reported from South African sandy beaches⁵. All phi quartile deviation values (Qd) are relatively low, indicating good sorting and a high proportion of particles falling within a narrow range around the median. The extremely low skewness (SK ϕ) values indicate that there was equal sorting of particles both larger and smaller than the median. The mean median diameter of the particles of both the beaches was different, indicating differences in exposure and wave action^{8,9}. Sediment temperature recorded on both beaches did not show any appreciable difference except some obvious changes between HWM and LWM.

Macrofauna—Table 2 shows macrofaunal density and biomass recorded at two beaches. Total faunal density was maximum at 0 m on English Point

Table 1—Summary of Sediment Characteristics of Two Beaches at Mombasa

Beach	Level (m)	Md (mm)	Md ϕ	Qd ϕ	SK ϕ	Grade	Mean Md (mm)	Sed. temp. ($^\circ\text{C}$)
English Point	0	0.13	2.95	0.40	-0.14	Fine sand		27.2
	10	0.29	1.85	0.15	0.00	Medium sand		26.5
	20	0.28	1.92	0.10	-0.01	-do-	0.25	25.5
	30	0.33	1.55	0.37	+0.15	-do-		25.1
Nyali beach	0	0.14	2.80	0.22	-0.03	Fine sand		27.0
	10	0.16	2.60	0.35	0.00	-do-		26.6
	20	0.17	2.55	0.42	-0.07	-do-	0.16	26.0
	30	0.19	2.34	0.42	+0.02	-do-		25.6

(1632.m⁻²) and at 10 m. on Nyali Beach (2736.m⁻²). The total density was lowest at LWM on both the beaches. The most important component of the macrofauna on these beaches was the high density of isopods (51.4% on English Point and 58% on Nyali Beach) which is in confirmity with the observations reported from South African beaches¹⁰. Polychaets, though present on both the beaches, had high population on Nyali beach. However, cumaceans and bivalves were observed only at Nyali beach. In general, Nyali beach showed high macrofaunal density than the English point. A noticeable feature of these beaches was the reduction in the number of macrofaunal groups (taxa) coherent with the upsloping of the beach, a feature reported also for South African and Indian beaches^{5,11}. The distribution of biomass showed aggregation at the upper level on both the beaches (Table 2). The total biomass was higher at Nyali beach (44.80 g.m⁻²). This was mainly due to the presence of larger and heavier organisms like bean clam (*Donax* sp.) at Nyali beach.

Meiofauna—Meiofaunal density of both beaches are given in Table 3. The dominant and regularly occurring groups were nematodes, oligochaetes and harpacticoids. The other taxa included turbellarians, gastrotrichs, polychaetes, mystacocarids, tardigrades and crustacean nauplii. Nematodes were generally the dominant taxa in marine meiofauna¹² and harpacticoid increased in coarser sand^{5,9,13}. This seems to hold good in the present study also. From Table 3 it can be seen that nematodes dominate the meiofauna and contribute 47.96 and 62.39% at English Point and Nyali beach respectively. The harpacticoids were common (25.25%) at English point where the sediment was coarser than at Nyali beach (13.18%). Oligochaetes although never reached highest number are important because of their relatively larger size¹⁴. Their contribution was only 15.09 and 16.23% on English point and Nyali beach respectively.

While the major taxa occurred at all tide levels, their distribution was by no means uniform on both beaches. On English point beach, the highest number

Table 2—Macrofaunal Density (No.m⁻²) and Biomass (g.m⁻²)

Beach	Level (m)	Polychaeta	Amphipoda	Isopoda	Mysidacea	Cumacea	Bivalvia	Total population	Total biomass
English point	0	0	536	32	64	0	0	632	2.75
	10	0	80	572	48	0	0	700	1.5
	20	32	16	444	0	0	0	492	1.22
	30	48	32	16	96	0	0	192	1.5
Total		80	664	1064	208	0	0	2016	6.97
Nyali beach	0	236	0	616	0	0	32	884	7.79
	10	268	0	524	64	16	128	1000	27.75
	20	432	96	176	0	372	16	1092	8.16
	30	208	48	48	0	264	0	568	1.6
Total		1144	144	1364	64	652	176	3544	44.80

Table 3—Number of Meiofauna Recorded on English Point and Nyali Beach
[Numbers are per 10 cm² surface area]

Beach level (m)	Sampling depth (cm)	Nematoda	Oligochaeta	Harpacticoida	Others	Total
English point						
0	0 - 10	1864	421	64	153	2502
10	0 - 10	424	142	743	235	1544
20	0 - 10	432	128	249	204	1013
30	0 - 10	316	264	542	146	1268
Total		3036	955	1598	738	6327
%		47.98	15.09	25.25	11.66	
Nyali beach						
0	0 - 10	1291	231	52	143	1717
10	0 - 10	878	121	81	103	1583
20	0 - 10	1476	537	329	218	2560
30	0 - 10	1341	408	192	190	2131
Total		4986	1297	1054	654	7991
%		62.39	16.23	13.18	8.18	

of meiofauna occurred around HWM (0 m) and the number dropped gradually downshore, a feature not common for sandy beaches and has been reported only by McLachlan⁵ for a South African sheltered beach. On the other hand, the distribution of meiofauna on more exposed Nyali beach was found to be aggregated downshore and decreased towards HWM. Ganapati and Rao¹⁵ and McIntyre² found maximum numbers at mid tide levels on exposed beaches and Wieser¹⁶ also came to similar conclusions.

The result of the 'anova' for the total meiofauna showed statistically significant differences in the total meiofaunal number at 2 sites (Table 4). This is attributed to various factors (both biotic and abiotic) which vary from site to site within the beach. Similar test (anova) was carried out for macrofaunal numbers. However, no significant results were obtained.

Comparison of macrofauna and meiofauna—As far as number is concerned the macrofauna/meiofauna ratio was high. The ratio (given below) for the 2 beaches falls well within the range 1/0.09 to 1/42458

Beach	Mean number (m^{-2})		Ratio
	Macrofauna	Meiofauna	
English point	2016	6330000	1/3140
Nyali beach	3544	7991000	1/2255

recorded by others¹². However, McLachlan⁵ has reported high ratios (between 1/17830 and 1/1540000) for South African beaches. Such differences are mainly due to differences in sampling techniques¹².

It may be concluded that both beaches have moderate macrofauna and rich meiofauna, a feature common to tropical sandy beaches. The high ratio of macrofauna/meiofauna in the present study suggests the suitability of sandy beaches as habitat for the establishment of permanent meiofauna population. It has been estimated that meiofauna contribute 28 to 55% of the total secondary production on South African sandy beaches⁵. From the data on population density recorded in the present study, a fairly high benthic production can be envisaged. It must however,

Table 4—One Way Analysis of Variance Table for Meiofauna Data After Transformation to \log_{10}

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F ratio
Between sites	0.256224	1	0.256224	10.13303*
Within sites	0.151719	6	0.025286	

*Significant at 5% level.

be noted that the present observations are based on few samples collected in a month only. Marked seasonal fluctuations in fauna could always occur and therefore studies on annual cycle will provide relevant information on benthic production and their role in the secondary production of such beaches.

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