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# Effect of Hydrogen Sulphide on Benthic Fauna of a tropical Estuary

**G. Gopakumar and V.J. Kuttyamma***
*Marine Products Export Development Authority*
*Vallarpadom, Cochin - 682 031, India*

The distribution and abundance of some benthic organisms in the Kayamkulam estuary (a tropical estuary), revealed that polychaetes, tanaids, amphipods, isopods, bivalves, gastropods and nematods were the major groups of macrobenthic animals. Among these, polychaetes were the most abundant group in unpolluted area compared to hydrogen sulphide-polluted area. In the polluted area polychaetes and nematods were observed during the study period.

**Key words: Hydrogen sulphide, benthic fauna, Kayamkulam estuary**

Hydrogen sulphide in nature is produced by the decomposition of organic matter under anaerobic conditions. Certain heterotrophic bacteria use sulphate and other oxidised sulphur compounds as terminal electron acceptors in metabolism and excrete sulphide (Boyd, 1982). Apart from the natural production of hydrogen sulphide, the effluents from various sources serve as sources of hydrogen sulphide in the estuarine environment, creating conditions unfavourable for the organisms.

The distribution of benthic fauna in relation to environmental parameters in India is fairly documented (Damodaran, 1973; Sarma & Ganapathi, 1975; Kondalrao, 1984; McIntyre, 1968). The effect of pollution on benthos of Indian waters has been studied by Remani (1979), Remani *et al.* (1981, 1983). However information is scanty on the effect of hydrogen sulphide on the distribution of benthos in estuaries of India. Retting of coconut husk is widespread along the Kayamkulam estuary, a tropical estuary in South west coast of India. Hydrogen sulphide produced during this process is a major pollutant of the water bodies of this area. Therefore a study was planned to collect information on the hydrogen sulphide concentration and the influence of the same on the distribution and abundance of some benthic organisms in this estuary.

## Materials and Methods

Sediment samples were collected at fortnightly intervals from 4 stations in Kayamkulam estuary (Fig. 1) during February, 1990 to January, 1992. Station 1 and 2 were unpolluted areas (clear area), free of hydrogen sulphide, whereas stations 3 and 4 were areas polluted by hydrogen sulphide. Bottom samples were collected using a hand operated Van Veen Grab of 225 $cm^2$ gape. Five samples were taken from each station for the analysis of the fauna, thereby covering an area of 0.1125 $m^2$. The samples were sieved through 0.55 mm mesh sieve and this sieved materials were immediately preserved in 5% buffered formalin. The preserved samples were treated with rose bengal stain and then washed (Walton, 1952) and the animals were sorted and identified (Guide, 1921; Fauvel, 1953; Holme & Mc Intyre, 1971). Sulphide in the sediment was determined by the APHA method (1960) and

* Present Address: Cochin University of Science & Technology, Department of Marine Sciences, Cochin-682016, India

statistical analysis was done following Snedcor & Cocharan (1967).

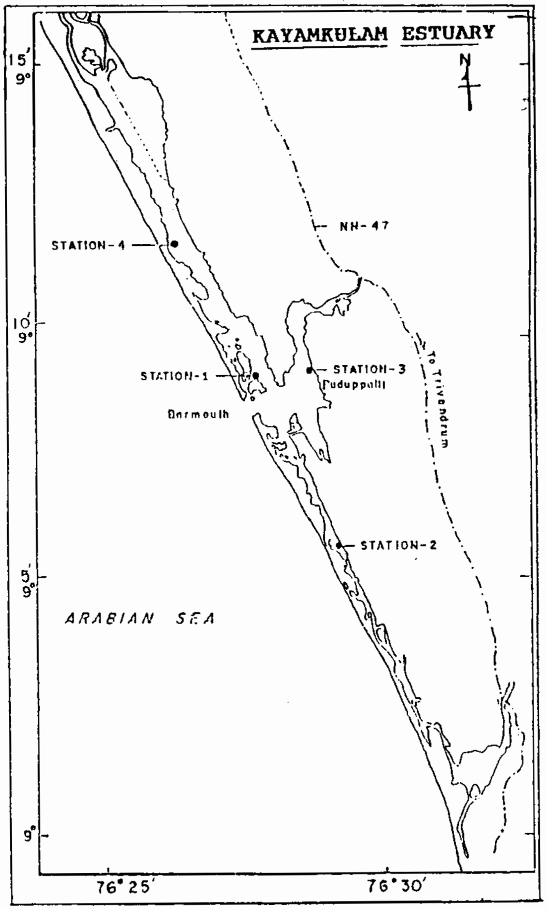


Fig. 1. Study Area.

## Results and Discussion

Numerical abundance of important benthic macrofauna collected during the period of study in different areas of the estuary are given in Table 1. The major groups of macrobenthic animals collected included polychaetes, tanaids, amphipods, isopods, bivalves, gastropods and nematods. Among these, polychaete was the most abundant group found at all stations. The number of organisms at stations 1 and 2 (unpolluted area) were much higher than that at stations 3 and 4 (polluted area) All the major groups of benthic animals were present in the unpolluted area whereas only two groups (polychaete and nematods) were observed in station 3 and only polychaete in station 4 during this investigation.

Statistical analysis revealed that there was no significant difference in the occurrence and abundance of organisms between stations 1 and 2 (unpolluted area) and also between stations 3 and 4 (polluted area). Mean comparisons revealed that the faunal abundance between stations 1 and 3, 1 and 4, 2 and 3 and 2 and 4 was significantly different. The number of benthic organisms observed at station 3 and station 4 were significantly lower than that observed at the other stations (Table 2).

Sulphide was present at all the four stations during the pre-monsoon period but was not detected in the soil samples at stations 1 and 2 during monsoon and post-monsoon periods. Sulphide values at stations 3 and 4 were very much higher than that at stations 1 and 2. The peak occurrence of sulphide at all stations was observed during the pre-monsoon period. The peak value of 0.92 µg $H_2S$ - S/g of soil was noticed at station 1 whereas at station 4 the maximum value recorded was 4244.7 µg during the same period (Table 3).

Salinity of water varied from 10‰ (monsoon) to 34‰ (pre-monsoon) at stations 1 and 2. At stations 3 and 4 the maximum value recorded was 30‰ (pre-monsoon) and minimum 8.5‰ (monsoon). Dissolved oxygen values ranged between 2.7 ml/l (pre-monsoon) and 4.60 ml/l (monsoon) at stations 1 and 2 whereas at stations 3 and 4 the minimum oxygen value noted was 1.76 ml/l (pre-monsoon) and maximum 3.99 ml/l (monsoon). Though the oxygen levels were low in the polluted area, it was not detrimental to the survival of benthos. The presence of low levels of oxygen in polluted area is mainly due to the high oxygen demand of hydrogen sulphide. pH varied between 8.44 to 7.68 at stations 1 and 2 while

Table 1. Distribution of macrobenthic fauna (number of organism/0.1m$^2$)

| | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec | Jan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION I | | | | | | | | | | | | |
| Polychaetes | 94 | 129 | 153 | 126 | 79 | 46 | 39 | 54 | 35 | 68 | 68 | 88 |
| Tanaids | 45 | 23 | 23 | 16 | 18 | 16 | 24 | 22 | 324 | 36 | 42 | 50 |
| Amphipods | 12 | 8 | 5 | 9 | 12 | 11 | 20 | 27 | 31 | 38 | 41 | 20 |
| Isopods | 2 | 1 | 1 | 2 | 5 | 7 | 1 | 6 | 0 | 7 | 11 | 10 |
| Bivalves | 5 | 8 | 6 | 3 | 4 | 8 | 1 | 0 | 1 | 2 | 6 | 12 |
| Gastropods | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 |
| Nematods | 9 | 11 | 11 | 9 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 1 |
| STATION II | | | | | | | | | | | | |
| Polychaetes | 53 | 93 | 108 | 120 | 94 | 64 | 40 | 22 | 25 | 45 | 43 | 61 |
| Tanaids | 25 | 12 | 9 | 8 | 12 | 24 | 13 | 33 | 42 | 18 | 24 | 10 |
| Amphipods | 12 | 10 | 9 | 11 | 10 | 13 | 16 | 16 | 21 | 20 | 13 | 16 |
| Isopods | 1 | 2 | 6 | 6 | 4 | 10 | 5 | 4 | 3 | 1 | 2 | 2 |
| Bivalves | 4 | 5 | 4 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 3 |
| Gastropods | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 9 |
| Nematods | 7 | 5 | 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| STATION III | | | | | | | | | | | | |
| Polychaetes | 10 | 9 | 7 | 6 | 8 | 8 | 3 | 8 | 3 | 8 | 18 | 15 |
| Tanaids | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 4 | 0 |
| STATION IV | | | | | | | | | | | | |
| Polychaetes | 10 | 7 | 2 | 3 | 8 | 5 | 6 | 5 | 1 | 5 | 12 | 11 |

at stations 3 and 4, the range of pH was from 7.54 to 6.50. pH of soil did not show much variation. pH values were low for both water and soil during the pre-monsoon period. The sediment of polluted area (stations 3 and 4) was black in colour with high sulphide content. The blackening of sediment in the polluted area was due to the local chemical reaction resulting in reduction of sulphate into sulphide (Hynes, 1966).

The quantitative and qualitative distribution of benthic fauna has a direct relationship with the nature and type of bottom deposit. The physical nature of the substratum acts as a limiting factor to a

Table 2. ANOVA

| SOURCE | DF | SS | MSS | F | REMARKS |
|---|---|---|---|---|---|
| Treat | 3 | 137684.800 | 45894.920 | 41.10 | (HI-SIG 1%) |
| Error | 92 | 102727.300 | 1116.601 | | |

| MEAN COMPARISONS | REMARKS |
|---|---|
| T1 - T2 | N.S. |
| T1 - T3 | SIG |
| T1 - T4 | SIG |
| T2 - T3 | SIG |
| T2 - T4 | SIG |
| T3 - T4 | N.S. |

Table 3. Total sulphide (µg H2S - S/g) in the sediment of the four stations

| Month | First year | | | | Second year | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | I | II | III | IV |
| February | – | 3.6 | 1414.2 | 2316.2 | – | 3.4 | 1320.6 | 2330.2 |
| March | 0.81 | 4.9 | 2619.0 | 4137.4 | 0.91 | 4.7 | 2725.6 | 3236.8 |
| April | 0.92 | 6.2 | 3128.9 | 4244.7 | 1.06 | 5.4 | 3238.6 | 4344.9 |
| May | 0.87 | 4.4 | 3027.4 | 4141.8 | 0.93 | 4.2 | 3127.5 | 4140.7 |
| June | 0.72 | 1.9 | 2910.1 | 3929.8 | 0.77 | 2.8 | 2812.3 | 4030.4 |
| July | – | – | 837.3 | 2165.5 | – | – | 918.0 | 2418.4 |
| August | – | – | – | 1111.7 | – | – | 215.0 | 1212.5 |
| September | – | – | – | 670.6 | – | – | 171.3 | 712.0 |
| October | – | – | – | 422.4 | – | – | 116.2 | 611.3 |
| November | – | – | – | 311.5 | – | – | 169.7 | 510.0 |
| December | – | – | – | 512.3 | – | – | 296.2 | 711.4 |
| January | – | 2.0 | 912.7 | 1292.3 | – | 2.2 | 870.3 | 1228.0 |

great extent (Thorson, 1957; 1958; Johnson, 1971). It was observed that polychaetes, tanaids, amphipods, isopods, bivalves, gastropods and nematods were the major groups of animals collected from the unpolluted areas (stations 1 and 2). On the other hand, in polluted areas (stations 3 and 4) only polychaetes were present. The number of these organisms per unit area was significantly lower in the polluted area than in the unpolluted area. Similar type of distribution of polychaetes in Cochin backwaters was reported by Desai & Krishnankutty (1967); Kurian (1972) and Pillai (1978). The same was the trend in the case of total number of animals also.

Crustaceans are detritophagus and therefore their distribution and abundance are related to the availability of the detritus (Pillai, 1978). However, in the present study a complete absence of crustacean fauna was observed in the polluted area, though these stations had large quantities of organic detritus. This may be due to the fact that only the most tolerant benthic animals survive in the anoxic condition created by the decomposition of organic matter and production of hydrogen sulphide. Unnithan *et al.* (1975) and Remani (1979) reported that the accumulation of organic material beyond the tolerance level affects the survival and consequently reduce the total number of crustaceans. Fincham (1969) suggested that the distribution of shallow water amphipods may be correlated with pollution and related factors such as low levels of dissolved oxygen. The complete absence of this group in the polluted areas observed during this investigation is in agreement with the above observation. Similarly, though the substratum at the polluted area was suitable for the burrowing polychaetes, their scarcity in the area may be due to the anaerobic condition and the presence of high sulphide content in the sediment. Thus it can be inferred that hydrogen sulphide is a major limiting factor in benthic faunal abundance and distribution.

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