

plumose setae (Fig. 1E). The posterior segments are crowded. A few posterior segments are missing in the present specimen.

In all characters, the present specimen fully agrees with the description of the type specimen.

The occurrence of *P. johnsoni* was first reported by Hartman¹ from the partly enclosed bays of southern California, from the longshore canyons at a depth of 97-230 m and from the southern United States in the littoral region. This was not reported by Day². However, Hartman³ reported *Poecilochaetus* from Madras Harbour but the species was not mentioned.

Occurrence of *P. johnsoni* in the Vasishta Godavari estuary is reported for the first time from the Indian waters. Work on the rich polychaete fauna inhabiting this estuarine system is in progress.

The authors thank Prof. K. Hanumantha Rao, Head of the Department of Zoology, for providing necessary facilities. One of them (D.S.R.) thanks CSIR, New Delhi, for award of junior research fellowship. Thanks are due to Sri A. V. Raman for confirming the identity of the specimen.

References

1. HARTMAN, O., *Atlas of the Sedentary polychaetous annelids from California* (Allan Hancock Foundation, Univ. of Calif., Los Angeles), 1968, 629.
2. DAY, J. H., *A monograph on the polychaeta of southern Africa, Part II: Sedentaria* (Brit. Mus. Nat. Hist. Lond.), 1967, 520.
3. HARTMAN, O., *J. Mar. biol. Ass. India*, 16 (1974), 192.

Observations on Faecal Contamination of Cherai Beach in Kerala

O. RAVEENDRAN, P. S. GORE & R. V. UNNITHAN

National Institute of Oceanography
Regional Centre, Cochin 682018

Received 17 September 1977; revised received 4 February 1978

Faecal pollution of Cherai during premonsoon, monsoon and postmonsoon seasons of 1976 is studied, and the counts of 'indicator bacteria' like *E. coli* and *Streptococcus faecalis* occurring in the beach sand and beach waters are presented. Based on FC/FS ratio, the faecal pollution in Cherai beach is primarily of nonhuman source.

FAECAL pollution of any given environment is primarily due to the sewage discharge and faecal matter both of human and nonhuman sources. Coliform and faecal streptococci constitute broadly the 'indicator' group of bacteria. Although several detailed studies on this group are available data on faecal pollution of beaches and sea water are meagre¹⁻⁶. A survey of the indicator species in a beach environment should throw considerable light on the sanitary condition and also serve as a guideline for the development of a tourist resort. Such a study has been undertaken on 2 beaches — Cherai and Fort Cochin of Kerala in 1976. The present paper deals with only Cherai, a more or less straight

beach, north of Cochin city. The data are collected during 9 months (April-December 1976).

Sand samples (approximately 15 g each) from a fixed transect along the Cherai beach were collected in small sterile petri dishes, using a sterile spatula. Surf beaten sea water was collected directly in a sterilized glass bottle. Sixteen samples were collected per month at fortnightly intervals. The samples were brought to the laboratory in iced condition and processed immediately. Sand samples (5 g) were weighed aseptically and mixed thoroughly with 100 ml autoclaved sea water. Sand samples were shaken well in order to release the adhering bacteria and 1 ml of this was plated on sodium desoxy-cholate agar. Water sample (1 ml) was directly plated. The plates were incubated for 24 hr at 37°C. The red colonies which appeared were taken as coliforms and the number was recorded. These red colonies were then streaked on eosine methylene blue agar (EMB agar) and the plates incubated at 45°C for 24 hr. Colonies with metallic sheen were identified as *E. coli*. When, however, metallic sheen was not developed within 24 hr a further incubation for 24 hr was carried out and the counts recorded as *E. coli*. These colonies were inoculated in test tubes containing bacto EC medium with inverted Durham tubes and incubated at 45°C for 24-48 hr. Faecal *E. coli* produced gas in the Durham tubes.

Detection of faecal streptococci was carried out as follows: processed sand and water samples were plated on KF agar medium and incubated at 37°C for 48 hr. KF agar medium had the following composition (%): proteose peptone (No. III), 1; bacto yeast extract, 1; sodium chloride, 0.5; sodium glycerophosphate, 1; maltose C.P., 2; lactose, 0.1; sodium azide, 0.04; sodium carbonate, 0.06; bromocresol purple, 0.0015; and agar, 2. Agar and proteose peptone were added to half of the distilled water and steamed until agar was completely dissolved. Remaining ingredients were added to the rest of the water and steamed for 10 min. The 2 mixtures were combined, filtered through cotton and bromocresol purple was added. After the addition of the indicator the medium was distributed in 100 ml quantities in 100 cc conical flasks and sterilized at 15 lb pressure for 30 min. Pink or red colonies of faecal streptococci developed after 48 hr. Parameters of sea water like dissolved oxygen, salinity, pH and temperature were also recorded.

Coliforms, *E. coli* and faecal streptococci occurred in most of the months both in sea water and in sand. From Table 1 it can be seen that coliforms, *E. coli*, and faecal streptococci were present in most of the months both in sea water and in sand samples, and the counts were higher during monsoon and immediately after monsoon (July-October). The counts were higher in beach sand than in water samples. High counts during monsoon and immediate postmonsoon months may be due to the low salinity and also due to lesser exposure to sunlight and temperature, since these organisms cannot tolerate high salinities even for 24-48 hr. Higher counts in beach sand compared to sea water may be explained by the fact that beach sand offers a

SHORT COMMUNICATIONS

TABLE 1 — OCCURRENCE OF DIFFERENT BACTERIA IN CHERAI BEACH DURING APRIL-DECEMBER 1976

(Values are average of 3 observations)

	Sand counts/g				Water count/ml			
	Coliforms	<i>E. coli</i>	Faecal streptococci	FC/FS	Coliforms	<i>E. coli</i>	Faecal streptococci	FC/FS
Apr.	7	2	5	0.4*	3	1	2	0.5*
May	11	3	8	0.3*	7	nil	2	—
June	17	4	9	0.4*	15	2	3	0.6*
July	17	6	9	0.6*	6	2	1	1*
Aug.	19	8	4	2†	11	nil	1	—
Sept.	19	4	3	1.33†	11	nil	1	—
Oct.	18	6	3	2†	18	3	nil	3†
Nov.	13	2	1	1*	10	nil	1	—
Dec.	7	1	2	0.5*	16	nil	nil	—

*Nonhuman faecal pollution.

†Human faecal pollution.

TABLE 2 — AVERAGE HYDROGRAPHICAL PARAMETERS

Month	Temp. (°C)		Dissolved oxygen (ml/litre)	Salinity ‰	pH
	Water	Sand			
Apr.	30.3	36	5.16	32.43	7.4
May	30.6	37.8	6.61	33	7.3
June	30.2	36	5.88	31.8	>7
July	27.5	38.2	6	24.1	>7
Aug.	28.3	37.2	6.15	25.4	7.5
Sept	30.1	40	7.03	30.81	7.5
Oct.	29.5	32.3	6.6	31.09	7.4
Nov.	29.7	31.7	6.73	32.03	7.5
Dec.	30.5	37.6	6.34	28.6	7.4

better substratum for the organism. As the salinity rises making the environment more and more marine the organisms get destroyed resulting in low counts. Gore and Singbal⁴ and Dwivedi *et al.*⁵ have reported *E. coli* counts from 2 sandy beaches of Goa; a maximum of 50/g of sand in Siridaon beach which is more estuarine and 10-15/g in Colva, a plain sandy purely marine beach. In the present study, the beach is marine and the count ranges between 7 and 10/g of sand. In this respect it resembles the Colva beach (Goa) revealing a more or less similar bacteriological status. There appears to be no significant effect of chemical parameters except salinity, on counts of the above organisms (Table 2). Since there is no significant variation in the pH values there appears to be no direct relation with bacterial counts.

Examination of faeces from a large number of animal species reveals that with one exception the faecal streptococci (FS) group outnumber the faecal coliform group (FC). But the FC of human intestines are more abundant than FS. This fact

may be utilized to distinguish between human and animal faecal pollution in waters. The available evidence suggests that FC/FS ratio in excess of 2, probably represents primarily human faecal pollution, while ratio of 1 or less may be due to nonhuman sources. Intermediate value cannot be interpreted reliably⁶. In accordance with this FC/FS ratio, the faecal pollution in Cheraï beach may be principally of nonhuman sources. FC/FS ratio for beach sand and sea water in various months is incorporated in Table 1. The results indicate that Cheraï beach is not free from faecal pollution. Considering the acceptable counts for coliform and *S. faecalis* given by Brisou⁷, in the beach under study the counts of coliforms ranging between 7 and 19 of sand and 6 and 18/ml in sea water, indicate that they are beyond the limit of acceptance; the faecal streptococci counts, however, do not fall within the acceptable range. In general, the counts of coliforms and *S. faecalis* both in sea water and in sand suggest that the beach is contaminated to a considerable degree during the monsoon and immediate postmonsoon months. However, the water did not show any macroscopic faecal pollution during the period of investigation.

The authors are thankful to Dr S. Z. Qasim, Director, and Dr T. S. S. Rao, Scientist-in-Charge, for encouragement. Thanks are also due to Prof. N. K. Velankar, Industrial Fisheries Consultant, Cochin University, for going through the paper.

References

1. REGNIER, A. P. & PARK, R. W. A., *Nature, Lond.*, **239** (1972), 408.
2. TINKER, J., *New Scient.*, **998** (1976), 238.
3. GORE, P. S., *Envir. Hlth*, **13** (1971), 115.
4. GORE, P. S. & SINGBAL, S. Y. S., *Fish Technol.*, **10** (1973), 55.
5. DWIVEDI, S. N., GORE, P. S., BHARGAVA, R. M. S. & RAJGURU, S. R., *NIO Report* (1974), August.
6. FINSTEIN, M. S., in *Pollution microbiology* (Dikker Inc., New York), 1972, 127.
7. BRISOU, J., *Bull. Wild Hlth Org.*, **12** (1968), 949.