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NOTE

Occurrence of tarball and waste materials on the beaches along Kerala coast in India

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Abstract

Results of a study conducted during 2000-2001 on the contamination of nine beaches along Kerala coast by solid waste materials and tar balls are presented. The level of solid waste contamination was higher in urban area due to anthropogenic activities, which included discarded pharmaceutical drugs, antibiotic preparations, cement bags, plastic water bottles, thermocol pieces and carry bags. Major tar ball deposits were observed on the beaches north of Cochin especially at Cherai (2.5 g/m^2), Kaipamangalam (2.2 g/m^2) and Chavakad (3.1 g/m^2) during April and May 2001. The quantity of tar ball deposit was significantly correlated ($P< 0.05$) with the wind velocity. The results were discussed in relation to their possible impacts on the state of health of coastal flora and fauna.

Coastal zones are vulnerable to pollution because of increasing anthropogenic activities like fishing, recreation, transport and aquaculture. Beaches have turned out to be dumping sites of domestic wastes, industrial effluents, hydrocarbons and solid waste materials. World's ocean system has been subjected to 9149 cases of oil spills between 1970-2000. A total of 53,22,000 tonnes of oil has been spilt into the ocean during the above period. Tar balls are residues of oil released to the marine environment. Being lighter than seawater, they float on the surface until they reach and settle on beaches. The occurrence of tar ball residues on beaches has been reported on an almost global scale (Jeffrey, 1980).

Contamination of polycyclic aromatic hydrocarbons (PAH) even in soils of Antarctica has been reported (Jackie *et al.*, 1999) and the predominant PAH fractions to be naphthalene and its methyl derivatives. Occurrence of tar like material on the beaches of Goa and Ratnagiri during June 1972 was reported by Nair *et al.*(1972) and from Narakkal beach, Cochin in 1998 by Kaladharan *et al.* (1999). The coastline of Kerala extending upto 690 km is intercepted by fishing harbours, ports, tourist resorts, bridges, mangrove beds, river mouths, boat yards, sandy beaches, etc. To assess the sanitary status along the Kerala coast, monthly observations on the quantity of tar ball contamination and other solid waste material deposited on the beaches were made during October 2000 to September 2001

and the results form the basis of this communication.

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Material and methods

Tar balls and solid waste materials were collected as per the standard method (IOC., 1984) from one square meter quadrats, selected randomly within one km transect from selected beaches from south to north along Kerala coast such as Thrikunnapuzha (Lat.9°15' 55" N and Long. 76° 24' 14.3" E), Purakkad (9° 20' 26. 0" N; 76° 22' 10.4" E), Alleppey (9° 29' 30. 0" N; 76° 19' 04.3" E), Mararikulam (9° 36' 04. 6" N; 76° 17' 53.4" E), Andhakaranazhi (9° 44' 53. 4" N; 76° 17' 06.3" E), Puthuvypu (10° 00' 00.0" N; 76° 13' 20.0" E), Cherai (10° 08' 18.4" N; 76° 10' 45.6" E), Kaipamangalam (10° 20' 07.3" N; 76° 06' 56.1" E) and Chavakkad (10° 34' 38.4" N; 76° 00' 18.8" E) every month for a period of one year from October 2000 to September 2001). The geographical position was recorded from a portable GPS (Garmin 12). The sand collected from each quadrat was sieved through 2 mm sieves and the residues were saved carefully in separate polythene bags. Wind velocity and direction were simultaneously recorded using a portable anemometer (Wind Vane Model Dynolab HHW 101. The materials collected from all the quadrats of a transect were pooled together, sorted into tar, shells, wooden, plastic, tin, rubber and vegetable waste, etc. The tar balls obtained were cleaned with a fine brush to remove sand particles adhered if any, weighed and recorded the quantity per square meter area. The correlation between quantity of tar obtained from each station was attempted with the wind speed and direction for significance (Freund and Walpole, 1987).

Results and discussion

The month wise data on biodegradable as well as non-degradable items dumped along the coast particularly on beaches between Thrikunnapuzha and Chavakad over a period of one year are presented in Table 1. Our observations showed that beaches at Puthuvyppu and Cherai stations north of Cochin as well as Andhakaranazhi south of Cochin are more contaminated than the other beaches studied (Table 1). The contaminants included pieces of thermocol, polyurethane foams (PUF), soft drink sachets, electric bulbs, night soil and discarded drugs (date expired) indicating the degree of anthropogenic interferences in these beaches adjoining Cochin. The suburban locations situated north of Cochin such as Chavakkad, Kaipamangalam and Thrikunnapuzha and Purakkad in the south were comparatively cleaner, indicating less anthropogenic activities. However, these areas showed the presence of vegetable wastes such as *Eichhornia*, *Salvinia* and coconut husks brought by river run off.

PUF and antibiotic suspensions discarded will have greater impacts on the

Table 1. *Occurrence of solid waste materials collected monthly from some beaches in Kerala during 2000-2001. (Letters in each column represent the months in which the waste materials were observed such as J-January, F-February, M-March, A- April, My- May, Jn- June, Jl-July, Au- August,S - September, O- October, N- November, D- December)*

	Trikkunnapuzha	Purakkad	Allepey	Mararikulam	Andhakaranazhi	Puthuvypu	Cherai	Kaipamangalam	Chavakkad
Antibiotic capsule strips				O	O	O			
Antibiotic oral suspension						O			
Beer cans		D						My	
Bivalve shells		Jl	S	M, Jl	F, M,A, S	O, N, S	O, N, M, Jn, Jl, Au,S	O, N, F, Jn	O, F, A, Jn, Au
Cement bags					F, Jn	O	J	N	
Chappal				D, J	O	Jn	O, Jl		N, M
Charcoal	O	N	D	O	O,N, J, M, Jl, Au			J	M
Cigarette / *beedi* butts		O,D, M	O,Jn	N,J,Au	O,N,S	N,J,F,S			
Cigarette lighter		O			D	O	O		
Coconut husk shell		O, Au	O	N	O	O,Au	O, Au	O, Au	
Cowdung						O,N, M, F,Jl, S			
Cuttle bone		D, Au	D, My	N, J	O, D	O, Au	O, Jn	O, F	O, M
Disposable plastic cup			O,,S	N, J,Ju	D,F,Jl	O,M	O		
Dry sea weed		J	D, J, M	J	M			A	
Eichhornia (dry)	O, S	O, Jn, Jl, Au, S	O, N, Jn, Jl, S	O, N, D, J, Jn, Jl, S	O, N, D, My, Jl	O, N, Jn, Jl, Au	O, N, J, Jn, Jl, Au	O, N, Jn, Jl, Au	O, N, My, Jl
Electric bulb			N	D,Jl, S	N, S	O	N		
Glass bottles		D				J		My	
Ice cream cup				O, M, My			My		N
Mangrove seed (dry)		Jn	A	N, M	My			My	A, Jn
Match sticks							J		J
Mica granules						A	F	F, M	F
Mineral sand	N, J, F, M, A, Jn, Jl, S	F, M, A, S	Jl	M, Jl, S			M		
Night soil	N, J	A, Jl	O,D, My, Jl	D, A, Jn, Jl, S	O, N, M, A, Jl	O, J, F, A, Au	O, M, A, Au	F, Au	O, M, Jl, Au
Nylon net pieces	D	D		F	F		J		O, N, J

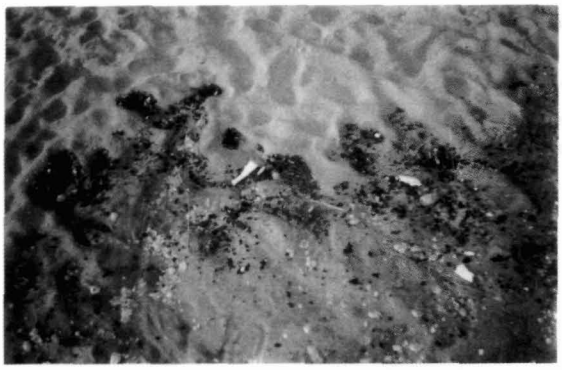

Fig. 1 *Occurrence of tarball at Cherai beach during August 2001*

beach ecology than other solid waste materials observed. Plastic bottles and pieces floating across the seas could be the transporters of the seeds of ecological chaos for wherever they end up. The Cambridge based Antarctic Survey (BAS) reports (Down to Earth, 2002) that rise in the plastic debris has replaced wood as the major shore line debris and this provides a vehicle and rafting opportunities for invading species such as bryozoans, barnacles, polycheate worms, hydroids, molluscs, etc.

During the year 2001, major tar ball deposit along beaches north of Cochin in appreciable quantities (Table 2) was observed in April especially in Cherai, Kaipamangalam and Chavakkad beaches and it continued till May. Cherai and Alleppy beaches also experienced tar deposit in appreciable quantities during August (Fig.1). However, the quantity of tar deposit reported by us is not exceeding the levels reported earlier from Goa-Ratnagiri region (Nair *et al.*, 1972) and from Narakkal beaches (Kaladharan *et al.*, 1999).

Nearly 750 –1000 tonnes of tar get deposited along the west coast of India every year (Sen Gupta *et al.*, 1990). As per the 1979 estimates, 357 million tones of oil from the Gulf countries (35.3 % of total transportation from Gulf) moved through the EEZ of India and intensities of oil slick were highest along the tanker rout in the Arabian Sea. The amount of floating tar in the Arabian Sea has been estimated as 3,700 tonnes and the tar-like residues have been reported on the beaches of every country bordering the northern Indian Ocean. It has also been estimated that approximately five million tonnes of oil enters the Arabian Sea every year, while

Table 2. *Weight of tar and details of wind observed from some beaches in Kerala during 2000-2001.*

Station	Date of collection	Wt. of tar (g/m^2)	Wind speed(m/sec)	Wind direction(°)	Wave direction	Tide
Purakkad	16.12.2000	6.93	2.6	270	W	Low
Alleppy	28.08.2001	1.17	1.0	345	W NW	High
Mararikulam	26.05.2001	1.70	1.2	080	W	Low
Cherai	28.04.2001	2.5	2.0	330	N NW	Low
	22.08.2001	0.1	1.9	350	W	High
Kaipa-	28.04.2001	1.3	1.6	250	W	Low
mangalam	15.05.2001	2.2	2.1	320	N NW	Low
Chavakad	28.04.2001	1.8	1.8	250	N NW	Low
	15.05.2001	3.1	2.5	340	NW	Low

Bay of Bengal gets 0.4 million tonnes only (Sen Gupta *et al.*, 1990).

The fate of oil spill depends on the climate of the location and the density of oil. After evaporation, emulsions of water in oil and oil in water may form and ultimately result in tar balls or lump (Jeffrey, 1980). In our study the weight of tar was significantly correlated ($P<0.05$) with the wind velocity ($r = 0.6678$) and not with wind direction. An oil slick might disappear as far as visual sighting on the surface of water is concerned, but petroleum hydrocarbons persist and can have a long-term impact on coastal environment. In the last five years, 75 percent of sea bird death reported in Newfoundland were as a result of oil discharge as the oil destroys the insulation of the feathers of seabirds (Down to Earth, October 2002). It is known that oil-spill residues have killed indirectly 60% of the Galapagos Islands' iguanas (*Amblyrhynchus cristatus*). The oil spill had killed the bacteria that help the iguanas digest the seaweed (Down to Earth, July 2002). The diesel spill occurred in the Mangalavanam an international bird area (IBA) of Cochin, choked the mangrove plants *Acanthus ilicifolius* growing on the mud flats resulting in the wilting and drying (Kaladharan and Nandakumar, 2003).

The alarming magnitude of tar that gets deposited along the west coast of India (Sen Gupta *et al.*, 1990) warrant immediate steps to check the oil spill and to conduct micro level investigations on the fate of tar being deposited every year.

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