

indicator for Pb and Se enrichment. *Patella* and *Hyale* should also be considered.

ALAA R. ABDEL-MOATI
MANAL M. ATTA

Oceanography Department,
Faculty of Science,
Alexandria University,
Moharam Bay, Alexandria, Egypt

Roméo, M. & Gnassia-Barelli, M. (1988). *Donax trunculus* and *Venus verrucosa* as bioindicators of trace metal concentrations in Mauritanian coastal waters. *Mar. Biol.* **99**, 223–227.

UNEP/FAO/IAEA/IOC (1984). Reference methods for marine pollution studies. No. 7 Rev. 2. UNEP, 1984.

Marine Pollution Bulletin,
Volume 22, No. 3, pp. 150–151, 1991.
Printed in Great Britain.

0025-326X/91 \$3.00+0.00
© 1991 Pergamon Press plc

Tar Balls on Ibeno-Okposo Beach of South-east Nigeria

Beach contamination by tar balls due mainly to operational losses of fossil fuel hydrocarbons from drilling platforms and terminal or tanker-derived oil spills is a common phenomenon in areas where there is intense oil exploration and exploitation.

The present work is a part of a research project that the Institute of Oceanography, University of Calabar has been undertaking since 1984. The aim of this study was to assess quantitatively the standing stock of tar and to investigate the prevalent oceanographic factors influencing the level of tar on the beach.

The study area stretches from the Qua Iboe River estuary to the Cross River estuary. Between the two estuaries there are a few fishing settlements and such areas were avoided due to increased human activity.

Along the beach front 30 stations were surveyed monthly. The entire beach front of 25 km was covered in 2–3 days during each field trip. Tar ball collection at each of the stations was done by marking out a 1 metre strip running up the beach from the water line to the supralittoral. Sampling involved picking up all visible tar on the surface and upper 2 cm of the sandy beach at or near the time of low tide. Preliminary clean up and quantification followed the method described in Intergovernmental Oceanographic Commission (IOC) Manual No. 13 (1984). Longshore current velocity, breaker wave types, water temperature, wind speed and direction were measured as described by Enyenihi & Antia (1985).

The monthly mean concentration of tar residues collected along Ibeno-Okposo beach are given in Table 1. The highest amount of tar collected per month during the period was $1.39 \text{ g m}^{-2} \text{ m}^{-1}$ in January and the lowest $0.04 \text{ g m}^{-2} \text{ m}^{-1}$ in October. Comparatively, the maximum value was lower than the amount collected in 1985, $3.75 \text{ g m}^{-2} \text{ m}^{-1}$ (Enyenihi & Antia, 1985) and 1986, $1.86 \text{ g m}^{-2} \text{ m}^{-1}$ (Enyenihi *et al.*, 1989). Generally, high levels of tar were recorded between January and May ($>0.30 \text{ g m}^{-2} \text{ m}^{-1}$). Except in May, a low amount of tar was recorded during the rainy season (June–October, $<0.2 \text{ g m}^{-2} \text{ m}^{-1}$). Tar balls were collected during every field trip at nearly all the stations. Tar balls ranged $<10 \text{ mm}$ – 8.5 cm in diameter. Prevailing winds were generally offshore with an average wind velocity range of 1.76 – 4.68 m s^{-1} and longshore current velocity range of 0.12 – 0.34 m s^{-1} East. Mean water temperature varied 28.3 – 32.0°C . The dominant wave type was spilling breaker wave (Table 1).

The amount of tar obtained during the period was relatively low (maximum value of $1.39 \text{ g m}^{-2} \text{ m}^{-1}$) depicting a decrease of 62.93% from the maximum value in 1985 and 25.29% from that of 1986. Reduction in the amount of tar balls on beaches has been

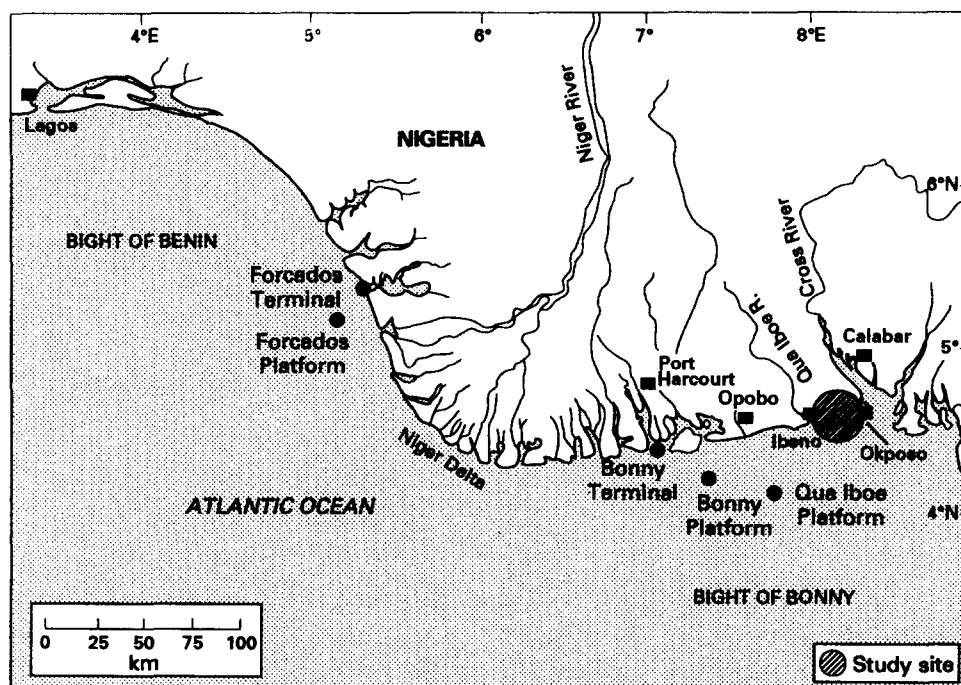


Fig. 1 Study site and major oil terminals along the Nigerian coastline.

TABLE 1
Monthly mean concentration of tar balls and prevalent oceanographic conditions in 1988.

Months	Tar balls g m ⁻² m ⁻¹ *	Wind speed m s ⁻¹	Longshore current velocity m s ⁻¹	Water temp. °C	Dominant wave	Prevailing wind
January	1.39 ± 1.41	3.92	0.15 W	30.5	Spilling	Offshore
February	0.65 ± 0.78	4.68	0.25 E	32.0	Spilling	Offshore
March	0.42 ± 0.49	1.76	0.21 E	31.5	Spilling	Offshore
April	0.78 ± 0.96	3.32	0.19 E	31.4	Spilling	Offshore
May	0.58 ± 0.52	3.58	0.30 E	30.6	Spilling	Offshore
June	0.19 ± 0.48	2.35	0.30 E	29.5	Spilling	Offshore
July	0.19 ± 0.28	4.65	0.34 E	28.5	Spilling	Offshore
August	0.11 ± 0.28	3.13	0.26 E	28.3	Spilling	Offshore
September	0.08 ± 0.10	1.78	0.12 E	28.3	Plunging	Offshore
October	0.04 ± 0.11	2.44	0.21 E	28.7	Plunging	Offshore
November	0.25 ± 0.37	2.31	0.21 E	30.1	Plunging	Offshore
December	0.29 ± 0.33	1.83	0.21 E	28.8	Plunging	Offshore

*Calculated monthly means for 30 stations.

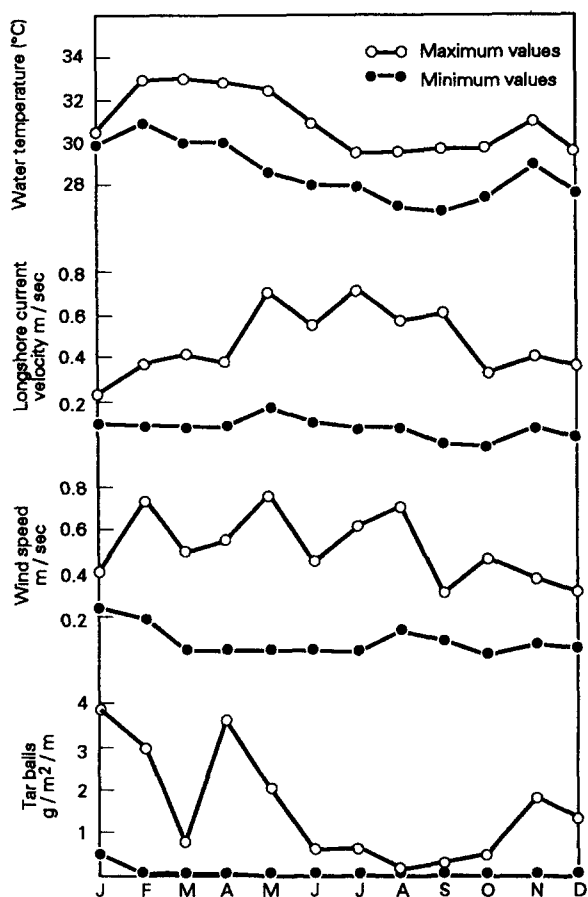


Fig. 2 Monthly distribution of minimum and maximum levels of tar balls and basic oceanographic factors on Ibeno-Okposo beaches.

reported from other regions of the world (Golik & Rosenberg 1987). Reduction was mostly attributed to reduced oil tanker traffic, enforcement of regulations on waste disposal at sea and to systematic cleaning of the beaches. The cause of the reduction during the present study is attributed to the absence of reported major oil spill incidents suggesting that only relatively small amounts of oil entered the marine environment from minor spills.

With the presence of large offshore oil platforms adjoining the beach under study, high levels of tar balls would have been expected to be deposited on the beach due to the combined effects of spilled oil from offshore production and other sources. The extremely low value of tar recorded during this study is partly attributed to the short beach front caused by the existence of transient beach scarps and partly to the influence of dominating spilling breaker waves that are associated with flat beach profiles (Antia & Nyong 1986). The beach scarps impede the transportation of tar to the supralittoral thereby limiting the amount of tar left by waves after each swash action.

The author is grateful to Mr. U. Umana for his assistance during field and laboratory work.

F. EMILE ASUQUO
Environmental Pollution Research Unit,
Institute of Oceanography,
University of Calabar,
P.M.B. 1115,
Calabar, Nigeria

Antia, E. E. & Nyong, E. E. (1986). Preliminary field studies on the relationship between breakers and beach pollution along the Nigerian coastline. Vol. of Abstracts, 22nd Annual Conference and 25th Anniversary Celebration of Nigerian Mining and Geosciences Society, Port Harcourt, 9-13 March.

Enyenihi, U. K., Asuquo, F. E. & Antia, E. E. (1989). The levels of stranded pelagic tar residues on Ibeno beach, Nigeria. *Trop. J. Appl. Sci.* 2(1), (in press).

Enyenihi, U. K. & Antia, E. E. (1985). Tar balls as indicator of crude petroleum pollution on the beaches of Cross River State, Nigeria. First workshop of participants in the Joint FAO-IOC-WHO-IAEA-UNEP Pilot phase project on monitoring of pollution in the marine environment of West and Central African Region, Report No. 41, Annex 9, 1-8.

Golik, A. and Rosenberg, N. (1987). Quantitative evaluation of beach-stranded tar balls by means of air photographs. *Mar. Pollut. Bull.* 18, 289-293.

IOC (1984). Manual for monitoring of oil and dissolved/dispersed petroleum hydrocarbon in the marine waters and on beaches, IOC Manual and Guides, No. 13, 14.