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Survey of tar, oil, chlorinated hydrocarbon and trace metal pollution in coastal waters of the Sultanate of Oman

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PREFACE

The terms of reference of the mission, which took place from 25 September to 4 October 1980, were to carry out a quantitative survey of the extent of oil pollution along the coast of Oman and to determine the major sources of oil pollution.

The present report contains the results of the survey for oil slicks and tar balls in coastal waters and on beaches of the Sultanate of Oman. During the mission a number of environmental samples were taken for chemical quantification of oil as well as other substances. These analyses were conducted in the IAEA International Laboratory of Marine Radioactivity in Monaco and in the Kuwait Institute for Scientific Research.

Members of the mission team were as follows:

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Members of the mission carried out the work in their own scientific capacities. Therefore, their views and conclusions do not necessarily reflect the official views of the two sponsoring organizations.

The mission team wishes to thank the Government of the Sultanate of Oman for the material support furnished during the period of the survey. Special thanks are due to Mr. Salim Khalfan Fatah and Sultan Saif Al-Falahi of the Ministry of Communications and Mr. Zaid Ali Al Ghassani of the Council for Conservation of the Environment and Prevention of Pollution for their personal assistance and effective co-ordination of logistical support in the field. The helicopter transport provided by the Royal Oman Police Force and ground transport supplied by the Office of the Wali of Dhofar is acknowledged with appreciation. The survey was greatly facilitated by the advice and laboratory facilities furnished by Mr. Arnold E. A. McLeod of the Government Central Laboratory and through assistance with sample collection rendered by Mr. Mohamed A. Al-Barwani of the Directorate-General of

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*The International Laboratory of Marine Radioactivity operates under a tripartite agreement between the International Atomic Energy Agency, the Government of the Principality of Monaco and the Oceanographic Institute (Paris). The laboratory is situated in the Musée Océanographique in Monaco.

Fisheries. Photographic coverage of the survey was ably performed by Mr. Tibor Farkas, UNEP, Geneva. Translation and field assistance given by Dr. Saad El Wakeel, Consultant to UNEP's Regional Office for West Asia in Beirut is also greatly appreciated.

This report has been prepared within the framework of the Kuwait Action Plan.

CONTENTS

I INTRODUCTION

More than half of all oil transported in the world passes through the narrow Strait of Hormuz on the north coast of Oman. Estimations made in 1978 showed that approximately 160,000 m^3 of oil were contained in surface slicks in the Gulf and its approaches and that there was a clear increase in number and percentage of positive slick sitings near the Strait of Hormuz (Oostdam, 1980). For years there have been repeated reports by the local population of heavy tar loads on Omani beaches. This situation appears to result primarily from the practice of tankers discharging their ballast waters on inward-bound voyages before they reach the Gulf. The combination of heavy tanker traffic in the coastal area, insufficient deballasting facilities in the Gulf and lack of enforcement of national and international deballasting restrictions exacerbates the problem for the Gulf region. This is particularly true for Oman since it is situated at the entrance to the Gulf where most deballasting takes place. Ironically only about 4 per cent of all tankers loading in the Gulf call at Omani oil terminals.

Oman has perceived this oil pollution as a threat to its extensive fishing industry which covers a coastline of roughly 1900 km. Oil production in Oman is relatively small and the country is working to preserve its traditional sources of income. Seeking scientific documentation to support Oman's concern for remedying the situation through the establishment of deballasting facilities in the Gulf, the Oman Ministry of Communications requested the United Nations Environment Programme (UNEP) to arrange for a scientific survey of the extent of oil pollution along the Omani coast. In fulfillment of the request UNEP sought the collaboration of the International Laboratory of Marine Radioactivity (ILMR), Monaco, which was responsible for organizing and carrying out the scientific aspects of the survey that ensued. The goal of the survey was to document, in quantitative and qualitative terms, the present state of oil and tar pollution on beaches and in coastal waters.

Scope of survey

The survey took place during the period 25 September to 4 October 1980. Given the time available and Oman's long coastline (approx. 1900 km), the survey team concentrated on estimating the standing crop of tar on beaches as a preliminary assessment of the present extent of oil pollution along the Omani coast. Logistical support in the form of helicopters, small boats and land transport provided by the Omani Government permitted the surveying of 11 beaches* covering representative

*The selection of these stations was made prior to the survey in consultation with representatives from the Council for Conservation of the Environment and Prevention of Pollution, Ministry of Communications, Directorate General of Fisheries, Maritime and Sea Ports Affairs, Authorities from Port Qaboos and Port Raysut, Ministry of Petroleum and Minerals, Royal Oman Police Force, Meteorological Section of the Civil Aviation Department, Musandam Development Committee, Government Central Laboratory, Diwan of the Sultanate of Oman and the Office of the Wali of Dhofar.

coastal areas from the Strait of Hormuz to near the border with Yemen (figure 1a). During the entire period, wind and sea conditions were light and daytime temperatures ranged from mid-30s to low 40s °C. The south-west monsoon (May-September) which affects the southern half of Oman (UNESCO, 1976a) had just ended.

In addition to the beach survey, water, surface sediment, fish, oysters, mussels and neuston were sampled when time and location permitted (sampling locations are illustrated in figure 1b). Some of these samples have been chemically analysed for petroleum hydrocarbons, chlorinated hydrocarbons and selected heavy metals. Results of the beach tar survey are presented in section III of this report and those of the chemical studies are presented in section IV.

II GENERAL PROCEDURES

Logistics: Helicopters provided access to all beaches north of Al Qurum and on Masira Island. The remaining beaches were accessible by road from either Muscat or Salala. Boats for marine collection were provided by the Royal Oman Police Force, Raysut Port Authority and the Directorate General of Fisheries.

Tar collections: The beaches were surveyed using methods specified by UNESCO (1976b). At each location sites for three or four 1-metre wide transects were randomly selected. Transects were measured from the water's edge perpendicularly up the beach face to the high tide mark. A typical transect layout is shown in figure 2. All tar lumps within the 1-metre wide transects, which could be picked up between thumb and forefinger, were collected, placed in plastic bags and labelled. The tar from each transect was kept separately so that means and standard deviations could be calculated. Although an attempt was made to remove as much sand and shell material as possible from the tar ball surfaces, some of these particles inevitably stuck to the tar. The small additional weight of adhering particles was probably compensated for because some extremely small tar particles were not collected. Therefore no corrections for trapped sand and shell fragments were made. The collected tar was transported to the Government Central Laboratory in Muscat and each bag weighed to the nearest 0.5 gramme. This method has been shown to give an accurate assessment of the amount of tar on a particular beach transect regardless of the state of the tide or the width of the beach face (Anderlini and Al-Harmi, 1979).

Sediments: Surface sediments were taken with a small stainless-steel Van Veen grab sampler operated by handline. The surface layer (top 1 cm) in undisturbed grabs was carefully removed with a spatula and frozen in glass jars for hydrocarbon analyses. Separate aliquots from the same grabs were frozen in plastic Twirl Packs (R) for heavy metal and mineralogical composition analyses.

Biota: Mussels (Mytilidae) and rock oysters (Crassostrea margaritacea) were removed from intertidal rocks by hammer and chisel and frozen whole before dissection. Fish were caught by handline and immediately dissected. Neuston and pelagic tar were collected by towing a neuston sled or small plankton net along the sea surface for prescribed periods of time depending upon water and ship conditions. Small pieces of pelagic tar, if present, were carefully removed from the sample for eventual weighing, and the remainder of the neuston sample was frozen for metal analyses. All sampling gear and dissection instruments were precleaned and procedures were designed to minimize sample contamination from boats, gear and handling.

III SURVEY OF TAR AND OIL POLLUTION ON BEACHES OF THE SULTANATE OF OMAN

Summary

Over half of the world's crude oil supply is transported from the Gulf area via tankers through the narrow Strait of Hormuz which forms the northern boundary of the Sultanate of Oman. Repeated sightings of floating oil slicks in coastal waters and large quantities of tar observed on beaches prompted Omani officials to request scientific assistance in assessing the problems of oil pollution in Oman.

This report gives the result of a UNEP-sponsored survey carried out in co-operation with the ILMR of the IAEA conducted from 25 September to 4 October 1980. Quantitative beach sampling yielded average standing stocks of tar ranging from 5 to 2325 g/m of shoreline with an overall average of 224 g/m. Values are among the highest reported for any world area and show a trend of increasing levels of oil residues close to the Strait of Hormuz. All the beaches surveyed showed evidence of chronic tar deposition. The data supports the premise that tanker deballasting is a major source of oil pollution along the Omani coast.

Results and observations

Beaches near Hormuz

1. Bukha: Floating tar was sampled in waters approximately 2 km offshore from the beach station. The surrounding waters appeared very clear and clean and virtually no pelagic tar was noted in the sample. Because the bottom in this area was extremely rocky, sediments and water samples were taken approximately 15 km north near Khasab Bay. Tar, very fresh and sticky, was collected from three transects on Bukha beach just east of the harbour (figure 3). Quantitative estimates for tar balls for the three transects were as follows:

Transect	Length (m)	Tar (g)
a	27	315.0
b	13	1051.0
c	12	574.0
		$\bar{X}$ = 647.0

Oysters were also taken from nearby intertidal rocks for later analyses.

2. Isolated beach 3 km north of Bukha: Four transects of equal length were made between water line and the recent high tide mark. Fairly copious amounts of large tar balls were noted high up on the beach face mixed in with much natural and manmade debris (figure 4). This material must have been deposited during an earlier storm and was in such a large quantity that it was not practical to separate it from the large amounts of associated debris. Because of this difficulty and since it was

so far above the designated transects, it was not included in the transect estimate. However, for standing stock assessment, it is estimated that collections along the transect represented only one-third of the stock if the oil residues observed on the higher reaches of the beach were taken into account. The four transects gave the following results (not adjusted):

Transect	Length (m)	Tar (g)
a	50	174.0
b	50	304.0
c	50	1211.0
d	50	1413.0
		$\bar{X}$ = 775.0

It is interesting to note that while no pelagic tar was collected by neuston tows only 3 km to the south, tar was observed suspended in the water in the nearshore zone. Only very small specks were seen in the surface layer. However, larger tar balls were observed moving along the bottom toward shore. These were then deposited on shore in the swash zone.

3. Lima: Since time was limited, only a visual survey of tar on the rocky beach was made. The tar was more weathered than that found at either stations 1 or 2 on the Gulf side of the Strait of Hormuz. It was estimated that a similar average amount (i.e. 775 g/metre beach) as that noted for the transects at station 2 north of Bukha was present here at the time observations were made.

Oysters were collected from the rocks at the northern end of the beach.

Just south of Lima near the border of the United Arab Emirates, several oil slicks, one of which was very large (figures 5a and 5b), were observed from the air. These long bands of frothy oil parallel to the shore line, were several kilometres in length and appeared to be moving onshore. Bands of oil were noted as far south as Fujairah.

Beaches between Hormuz and Greater Muscat

4. Shinas: This long and steeply-sloped beach was composed of sand of a reddish-metallic colour. The winds were south-easterly and the surf was striking the beach face at a slight angle. The high berm showed signs of recent tar pollution (figure 6). This tar was very fresh and sticky. The inclusion of an encrusting rust-like substance suggests that it had originated from tanker washings. Above the berm zone were scattered dry, weathered tar balls encrusted with a green