ACTUAL SITUATION OF OIL POLLUTION IN THE ECOSYSTEM ALONG THE EGYPTIAN RED SEA COAST

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"Since the reopening of the Suez Canal in 1975, there has been an increase in petroleum production in the Egyptian territorial waters of the Red Sea (especially in the Gulf of Suez) as well as its transport across the Suez Canal. One consequence has been intensive oil pollution along the Egyptian Red Sea coast. To evaluate the effects of the pollution, 30 marine samples (sediments, algae, molluscs, and fish) were collected in April 1981, from 8 stations extending 500 kilometers from Suez to Safāga and analyzed by gas chromatography for total hydrocarbon content.

Because of the variations in the collected species, it was difficult to establish a spatial comparison along the coast. However, at certain stations, there were very high levels of hydrocarbons in species such as *Patella* sp. and *Nerita polita* from Ain Sukhna, *Atactodea* sp. from Al-Ghardaqa, and two species of fish (*Sardinella melanura* and *Lethrinus miniatus*) from Al-Ghardaqa. In general, the hydrocarbon levels from the species collected at Al-Ghardaqa were higher than those found elsewhere."

Introduction

Following the reopening of the Suez Canal in 1975, shipping and petroleum production from coastal and submarine oil fields in the Egyptian waters of the Red Sea have increased enormously, exceeding work of the pre-1967 period. As a direct consequence, oil pollution and concentrations of petroleum in Red Sea waters, sediments, and organisms should also have increased. Shipping, harbor wastes, and oil production, which are the essential sources of oil addition to the waters, are concentrated in the northern part of the Red Sea inside and near its two gulfs, Suez and Aqaba. Because of the seasonal water circulation and the northerly average wind throughout the year (UNESCO, 1974), the spilled oil and wastes in these regions could spread southwards and affect the whole Red Sea (more than 2,000 km in length, with a surface area of about 450,000 km^2).

Recently, the Suez Canal Authority implemented a wide range of accident prevention measures to minimize the quantities of oil that might be spilled in Red Sea waters through canal transportation (El-Ghamry, 1981). In spite of such measures, oil pollution will continue to threaten the Red Sea because the marine transport of oil and its production activities will probably increase at

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a higher rate than prevention measures can act to reduce spills and accidents (UNESCO, 1974).

There have been very few studies concerning the problem of oil pollution in the Red Sea. One series of laboratory experiments and long-term field studies attempted to determine the influence of oil pollution on the coral reef communities in the Gulf of Aqaba, which is a region stressed almost continuously (Loya and Rinkevich, 1980). Our limited program monitored the actual levels of petroleum hydrocarbons in some dominant shore organisms on the Egyptian coast of the Red Sea. Because of the lack of such data, our results should be considered as preliminary information for any future monitoring of oil pollution in the intertidal organisms of the Red Sea.

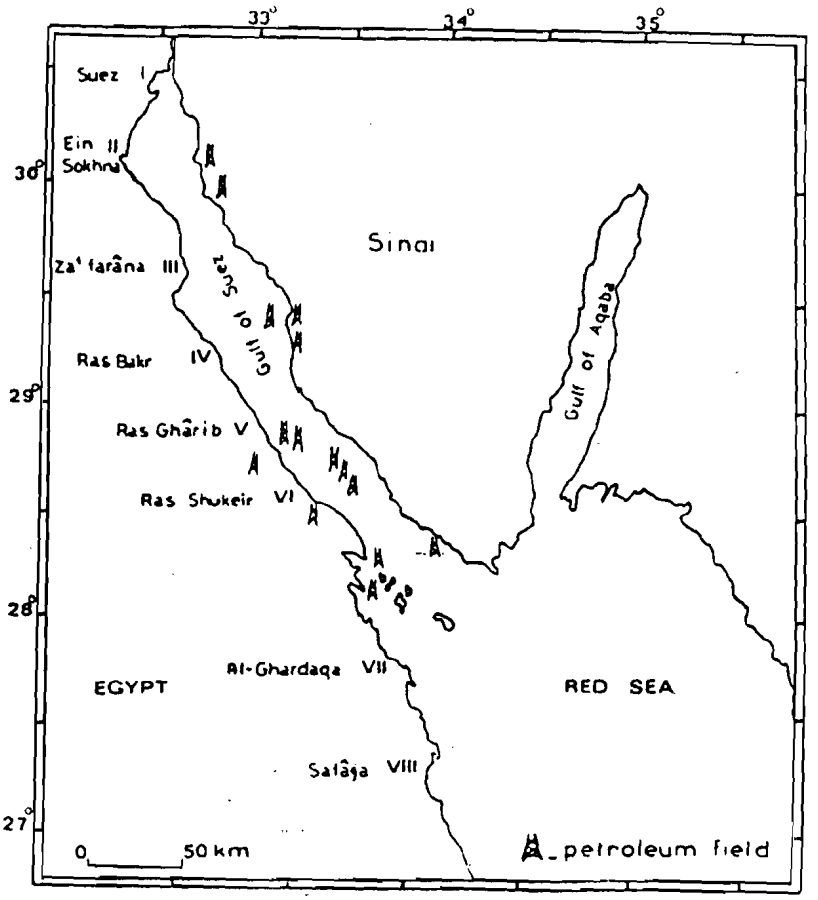

FIGURE 1. Sampling stations.

Sampling and Analyses

From eight stations on the Egyptian coast of the Red Sea, extending from Suez 500 km south to Safâga (Figure 1), 23 samples of intertidal benthic fauna and flora were collected during April 1981. Also, samples of 6 species of fish were collected in the vicinity of Al-Ghardaqa and Safâga (stations VII and VIII, respectively) as well as one sample of sediment from Za'farâna (station III). The benthic organisms included 13 algae samples representing 2 species of green algae and 4 species of brown algae, plus 10 samples of 6 species of molluscs (1 univalve, 4 bivalves, and 1 gastropod). Speciations and spatial distribution of collected samples are shown in Figures 2 and 3, which include the analytical results of total hydrocarbon content in each sample.

The work was done with limited facilities. As soon as the sample was collected, it was packed with aluminum foil and conserved in a portable freezer stocked with sufficient dry-ice. On arrival at the laboratory, the samples were deep frozen until the time of analyses. The hydrocarbons were

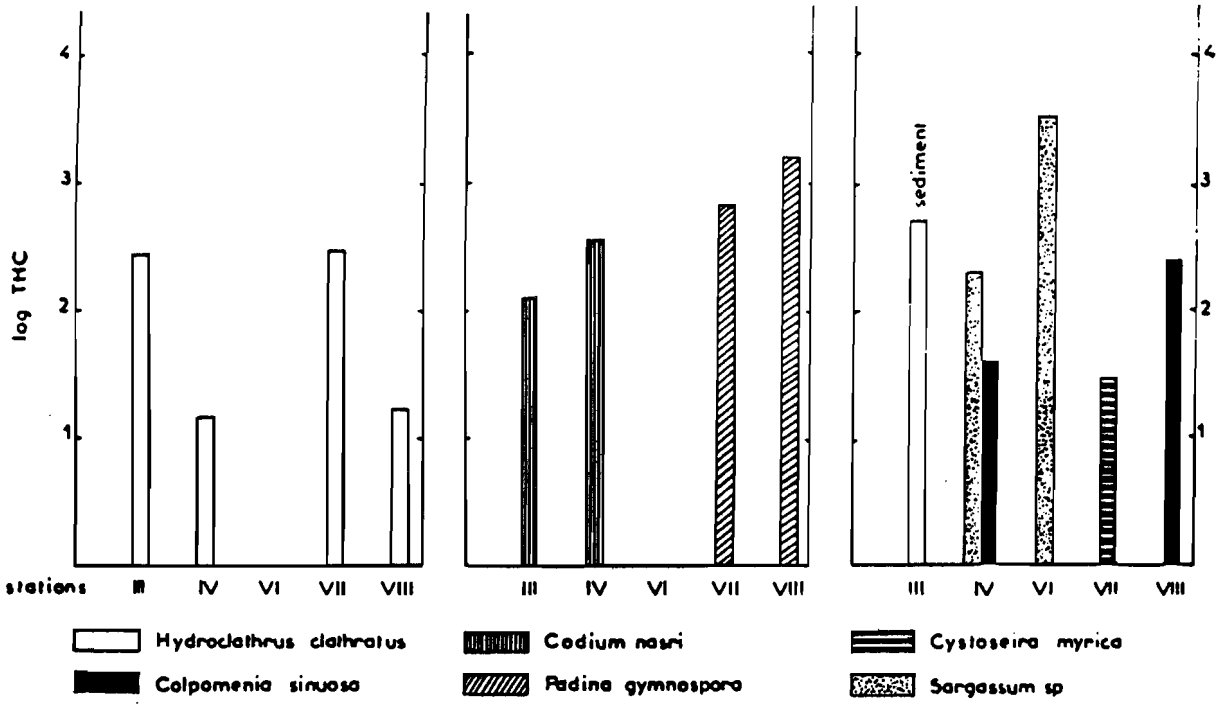

FIGURE 2. Total hydrocarbon content in mg/kg (dry wt.) detected in different species of algae and sediment collected in 1981 on the Egyptian coast of the Red Sea.

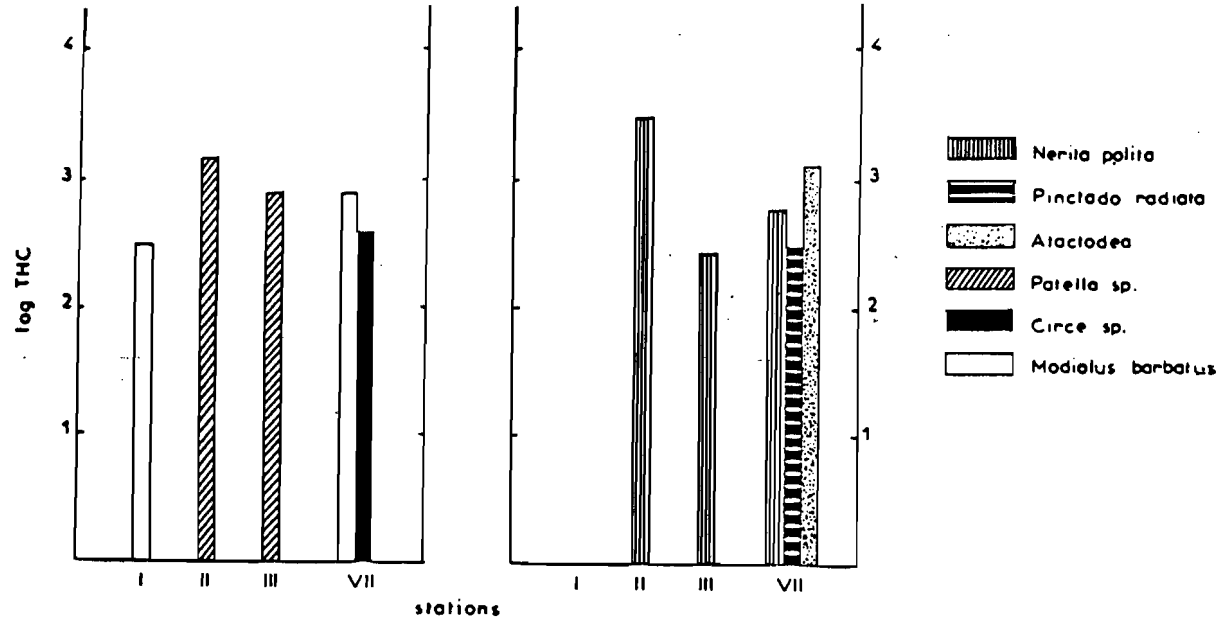

FIGURE 3. Total hydrocarbon content in mg/kg (dry wt.) detected in different species of molluscs collected in 1981 on the Egyptian coast of the Red Sea.

extracted from representative aliquots (which were dried at 60°C) following the technique of Awad (1981). We used gas chromatography to measure the total hydrocarbon content in the purified extracts produced from each sample.

Results and Discussion

First of all, we made some field observations during sample collection. The beaches were drastically fouled with residual oil, not only at the chosen stations but almost all along the coast from Suez to Safāga. There were numerous oil slicks either on the beaches or visible in the nearshore waters. Although some beaches appeared clean, removal of the sandy superficial layer revealed a bed of accumulated residual oil, which sometimes extended to a depth of tens of centimeters. Indeed, the rocks of the few rocky beaches were usually completely covered with oil slicks and lacked any sort of vegetation or benthic animals. Many spots contained considerable quantities of tar balls and lumps, most of which were fresh. In several cases, especially on the rocky beaches, aggregates of tar balls formed enormous clusters, such as the one about 50 cm in length and 2 kg in weight, which was found near Ras Shukheir (station VI).

Stations IV and VI completely lacked benthic animals; stations I and II lacked benthic algae; and only one species of organism was collected from stations I and VI: the bivalve *Modiolus barbatus* from station I and the green algae *Sargassum* from station VI. No sample was found in station V (Rās Ghārib), where the coast completely lacked any sort of intertidal marine organism. The observed paucity of species diversity and biomass along the investigated area could be attributed to the effects of actual intense chronic oil pollution. On the other hand, Al-Ghardaqa (station VII) showed the most variable intertidal community; among the many species there we collected 5 species of molluscs and 3 of algae.

Our goal was to establish a spatial intercomparison of the actual level of oil contamination in some species of benthic fauna and flora along the Egyptian coast of the Red Sea. However, the lack of at least 1 species representative of all stations prevented this. Only 2 species (the brown algae *Hydroclathrus clathratus* and the gastropod *Nerita polita*) were collected from several stations; the first was found at 4 stations, and the second at 3. For the rest of the samples, every species was collected at one or two stations. Although this group could not serve sufficiently for our work, they may be considered as preliminary data for similar projects in the future.

Sediment

Because our sediment collection was limited for the muddy type, only one sample was collected from Za'farāna (station III) with 488.5 mg/kg (dry wt.) total hydrocarbon content. This represents the various organisms collected from the same station, except that of the *Patella* (Figure 3).

Algae

As shown in Table 1 and Figure 2, all species of algae (green and brown) represent at least two stations except *Cystoseira myrica*, which was collected

TABLE 1. Total hydrocarbon content in mg/kg (dry wt.) for the various collected samples from different stations.

Sample	Station I	II	III	IV	V	VI	VII	VIII
Sediments	-	-	488.5	-	-	-	-	-
Algae								
Codium nasri	-	-	117.4	367.2	-	-	-	-
Hydroclathrus clathratus	-	-	273.8	14.9	-	-	277.1	16.6
Padina gymnospora	-	-	-	-	-	-	674.3	1516.9
Cystoseira myrica	-	-	-	-	-	-	25.4	-
Colpomenia sinuosa	-	-	-	35.5	-	-	-	235.9
Sargassum sp.	-	-	-	181.6	-	2863.6	-	-
Molluscs								
Modiolus barbatus	276.4	-	-	-	-	-	766.4	-
Patella sp.	-	1478.4	800.6	-	-	-	-	-
Nerita polita	-	2976.6	283.8	-	-	-	613.8	-
Circe sp.	-	-	-	-	-	-	372.3	-
Atactodea sp.	-	-	-	-	-	-	1277.5	-
Pinctado radiata	-	-	-	-	-	-	277.4	-

TABLE 2. Total hydrocarbon content (THC) detected in collected fish samples.

Species	THC mg/kg (dry wt.)	Station
Sardinella melanura	10876.9	VII
Lithrinus miniatus	6038.7	VII
Sparus nokt	151.0	VII
Family Theraponidae	133.0	VIII
Family Chanidae	620.1	VIII
Parupeneus barberinus	125.2	VIII

only from Al-Ghardaqa. The brown algae *Hydroclathrus clathratus* was more dominant than the other collected species of algae along the coast, where it was collected from four different stations. The measured values of total hydrocarbon content varied enormously among all species and among the samples of the same species collected from different stations. These values were scattered between 14.88 and 2863.6 mg/kg of dry sample in *Hydroclathrus clathratus* at station IV and the *Sargassum* at station VI, respectively. In 4 of the 6 considered species, the hydrocarbon content measured in the samples from the southern stations were usually higher than those in the samples from the northern ones. In the case of the dominant *Hydroclathrus clathratus*, the values measured in the samples from Za'farāna and Al-Ghardaqa were almost equal (273.8 and 277.1 mg/kg, respectively), representing about 18 times the values found in the same algae of stations IV and VIII.

Molluscs

The different species of molluscs are characterized by levels of hydrocarbon content higher than those detected in the algae species. In general, all of the species had values exceeding 270 mg/kg of dry wt. samples (Table 1 and Figure 3). As in the case of the algae, the samples of the southern stations (Al-Ghardaqa) usually had higher hydrocarbon levels than the same species from the northern stations (I and III), excluding those from Ain Sukhna (station II). In fact, the two molluscs from station II showed the highest levels of total hydrocarbon content -- 1478.4 mg/kg for *Patella* and 2976.6 mg/kg for *Nerita polita*. On the other hand, the level in the bivalve *Atactodea* (1277.5 mg/kg) was the highest value for the 5 species of molluscs collected from Al-Ghardaqa.

Fish

[illegible] the total hydrocarbon content in the 6 fish species sampled [illegible] *melanura* (10876.9 mg/kg) and *Lithrinus* [illegible] highest. Both of these species are represented [illegible] VII) -- the first nearshore and the [illegible] The hydrocarbon levels in the rest of the species [illegible] except for a small fish of the family Chanidae collected [illegible], which had a relatively higher level (620.1 mg/kg).

Conclusions

According to our measurements and observations, we can make the following conclusions:

1. The coast (highly fouled by oil slicks, accumulated tar balls, and tar clusters) and the paucity of intertidal organism diversity represent a situation of intense chronic oil pollution in the region extending from Suez 500 km south to Safāga. This oil pollution is a normal and direct consequence of the rapid expansion of petroleum activities and navigation in the Egyptian territorial waters of the Red Sea since the reopening of the Suez Canal in 1975.

2. The inevitable spills of petroleum and petroleum wastes in the northern part of the Red Sea, near the Gulf of Suez, could spread southwards by the

northerly average wind throughout the year. The higher total hydrocarbon content in the organisms of the southern stations (than those in the organisms of the same species in northern ones) may be due to either the effects of high oil accumulation in the south or incidental local oil pollution conditions.

3. The places on the coast that had a significantly high potential of oil contamination usually lay in the vicinity of an important oil activity (terminal of pipeline or oil field). Among the collected samples of molluscs, the highest level of total hydrocarbon content (2976.6 mg/kg) was found in the gastropod *Nerita polita* collected near the Red Sea terminal of the Mediterranean-Red Sea pipelines. On the other hand, the highest value (2863.6 mg/kg) was detected in the only species of algae (*Sargassum* sp.) collected near Ras Shukheir oil field.

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