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Levels of oil residues in some coastal lagoons, East of Libya

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Abstract- Four Coastal lagoons, namely Bomba, Katayta, Bardia and Um El-Shawish located in the eastern part of Libya investigated seasonally for oil pollution throughout the period from July 1998 to April 1999 at five stations. The lowest level of oil pollution was observed in summer while the highest level was observed in spring. There was an evidence of seasonal variation which is attributed to the environmental conditions prevailing in the specific ecosystem. Spectroflourometeric method have been adopted to measure the total concentration of petroleum hydrocarbons TPHs .Levels of TPHs ranged from 3.33 µg/l in summer to 27.91 µg/l in spring, in Bomba Gulf, in Katayta ranged, from 4.09 µg/l in summer to 27.09 µg/l in spring, from 3.50 µg/l in summer to 28.48 µg/l in spring in port Bardia, from 6.33 µg/l in autumn to 10.93 µg/l in winter, in Um El-Shawish Inlet. It was suggested that 10 µg/l indicate contamination of marine life with oil.

Key words: Lagoons, oil pollution, Mediterranean Sea, East Libya, Concentration factor.

Introduction

Coastal lagoons are bodies of water, separated in most cases from the sea by offshore bars or islands, of marine origin and usually parallel to the coast line. These lagoons are commercially important as they support fisheries and provide protected harbors. They are also very sensitive to chemical contamination, partly because as a result of chemical cycling, residence times of substances within them are long and this leads to the long-term retention of contaminants. This is particularly acute in contamination by heavy metals, which are often present in industrial wastes and also in fossil hydrocarbons (Mee, 1978).

Coastal lagoons and lakes, in general, are transitional zones of high productivity, zones between land and sea are sensitive to disturbance for instances; many are threatened by pollution (UNESCO, 1986). Data on the levels of petroleum hydrocarbons in the Mediterranean ecosystem have increased during the last 40-50 years, especially with regards to concentrations in waters and on beaches.

The circulation pattern of surface water in the Libyan coasts enables oil entering the Gulf of Syrte to be trapped and diluted (MFRC, 1981). Seasonal study has been conducted throughout the period from July 1998 to April

1999 at five stations. the four coastal lagoons, namely Bomba, Katayta, Bardia and Um El-Shawish located in the eastern part of Libya in order to examine the water quality to attempt to evaluating these lagoons for exploitation of fish farming.

The results obtained by Howege *et al.* (2000) show high values of TPHs in waters of the Gulf of Syrte. Oil pollution presents hazard along parts of the Libyan Marine Coast where Oil Industry are located, hopefully this study will contribute to understand oil pollution in these ecosystems.

Materials and Methods

A clean amber glass bottles (2.5 L) was used to collect 2 liters of the subsurface sea water samples from five sites were empirically chosen at each of the following coastal lagoons:

Gulf of Bomba 32˚24`N 23˚6` E, Um El-Shawsh Inlet 32˚3`N 21˚1`E, Marsa El Katayta 32˚2`N 24˚3`E and port Bardia 31˚45 ` N 25˚6` E. (Fig.1 and 2) (ENCART, 98).

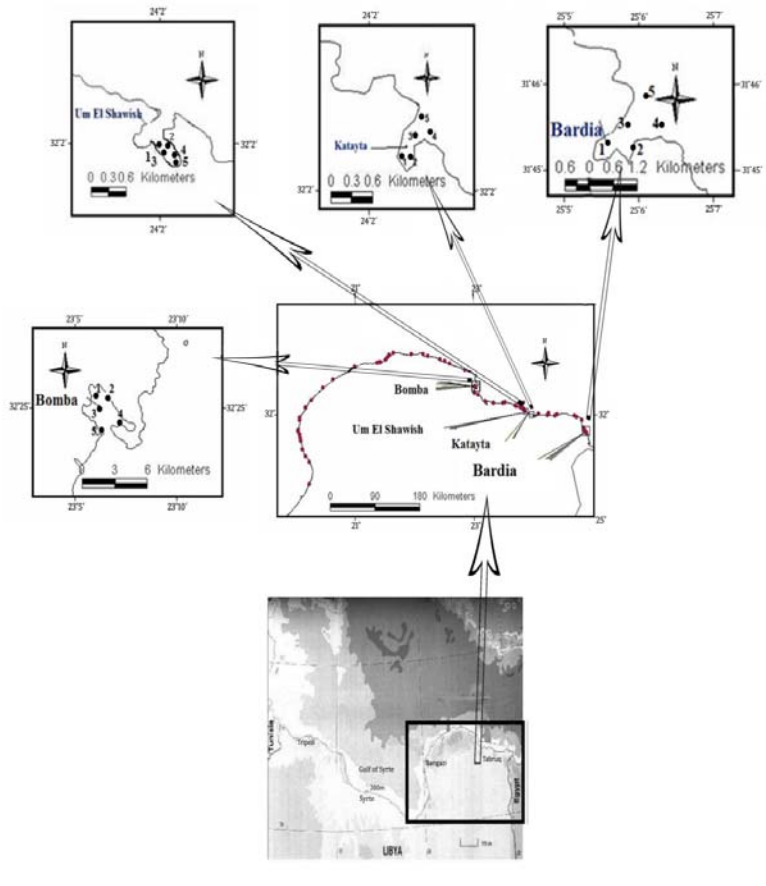

Figure 1. Showing the sampling sites.

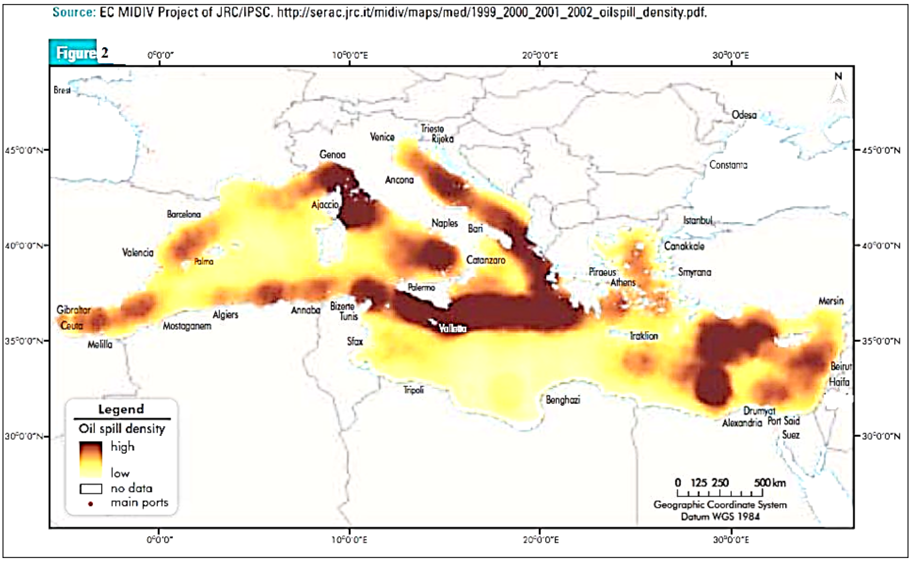

Figure 2. Showing the oil spill density from 1999-2002.
EC MIDIV project of JRC/IPSC. http://Serac.jrc.it/midiv/maps/ /1999_2000 _2001_2002_ oil spill density pdf

Subsurface sea water samples (2 liters) were collected with a glass bottle. Immediately after collection, the sea water sample was extracted with carbon tetrachloride. The organic extracts were set in a glass flask and kept for analysis at the laboratory. The organic phase was then reduced by evaporation to about 5 ml .The traces of water were removed with anhydrous sodium sulfate .The extract was then concentrated to dryness under a nitrogen stream and finally rediluted to 5 ml with hexane. Hydrocarbons were measured by UV spectroflurometry (Fluoromax), according to the method previously described (IOC-WMO-UNEP, 1977).

The excitation wave length was fixed at 310 nm .The emission spectra were set from 290 to 420 nm and maxima of fluorescence appeared at 360 nm. The spectroflurometer was calibrated with a solution of ROPME crude oil in hexane. Although only the aromatic compounds are detected by spectrofuorometry, the data are expressed in total hydrocarbons related to calibration crude oil solution.

Results and Discussion

TPHs concentrations (ROPME crude oil equivalents) found in the present study are shown in Figures (3 to 6). The amount of oil residues in sea water samples ranged from 2.12 µg/l at station 4 to 5.56 µg/l at station 2 in summer, from 3.377 µg/l at station 5 to 9.2 µg/l at station 1 in winter, from 5.665 µg/l at station 5 to 15.332 µg/l at station 1 in autumn, and from 19.58 µg/l at station to 41.36 µg/l at station 4 in spring, for Bomba coastal lagoon (Fig 3). The amount of oil residues in sea water samples ranged from

2.65 µg/l at station 5 to 6.19 µg/l at station 3 in summer, from 7.704 µg/l at station 2 to 25.872 µg/l at station 1 in winter, from 4.059 µg/l at station 4 to 8.496 µg/l at station 5 in autumn, and from 16.92 µg/l at station 3 to 37.19 µg/l at station 5 in spring, for Katayta coastal lagoon (Fig 4). The amount of oil residues in sea water samples ranged from 3.21 µg/l at station 1 to 3.88 µg/l at station 5 in summer, from 2.791 µg/l at station 3 to12.826 µg/l at station1 in winter, from 16.364 µg/l at station 2 to20.929 µg/l at station 5 in autumn, and from 10.46 µg/l at station 2 to 45.95 µg/l at station 5 in spring, for Bardia coastal lagoon (Fig 5). The amount of oil residues in sea water samples ranged from 5.16 µg/l at station 5 to 7.39 µg/l at station 3 in summer, from 10.926 µg/l at station 5 to 22.442 µg/l at station 4 in Winter, and from 4.334 µg/l at station 1 to 9.621 µg/l at station 2 in autumn, for Um El-Shawish coastal lagoon (Fig 6).

Table (1) list the lowest average oil concentration in Gulf Bomba from 3.33 µg/l in summer duplicate to 6.75 µg/l, raised slightly to 7.22 µg/l in autumn. The highest average value is 27.91ug/l recorded in spring in Bomba Gulf.

Marsa El Katayta is like a swimming pool, the lowest average value of oil concentration is 4.09µg/l in summer doubled to 8.38µg/l in winter, and then lowered to 6.25µg/l in autumn. The highest average value of oil concentration in Marsa el Katayta is 27.09 µg/l which is nearly similar to the value recorded to the Bomba Gulf.

The TPHs in the sea water of port Bardia ranged from 3.50µg/l in the summer season, to 18.13µg/l in autumn. The highest average value of TPHs is 28.48 µg/l in port Bardia was recorded in spring.

For the Um El-Shawsh Inlet, the average value of TPHs is 7.19 µg/l raised to 10.93 µg/l in winter, declined to 6.33 µg/l in autumn with no recorded data in spring due to technical difficulties.

Two general types of stresses are imposed on the chemistry of lagoons by human activities .The first arises from physical changes in the lagoon and its surrounding area and the second is due to chemical contamination.

From Figure (7), the lowest values of TPHs for the studied lagoons have been recorded in the summer and this is due to high temperature as evaporation rate doubled in summer season and this is in agreement with the result obtained by Greges (1993). The higher TPHs summer value of Um El-Shawish lagoon may be due to its proximity to Tubruk oil terminal as high hydrocarbon concentrations values were observed near oil terminal (DouAbul, 1984), and this is due to the loading operations.

The results obtained in spring for the coastal lagoons raised to highest level of TPHs and this is possibly due to the interaction of spring flourishing of phytoplankton as the biomass of phytoplankton reaches its peak in spring and declined at the beginning of summer (Abushagur and Dalhum, 2001). The concentration of dissolve petroleum hydrocarbons were negatively correlated with phytoplankton biomass measured as chlorophyll (a) near the oil tanker route in the southern Bay of Bengal whereas a positive correlation was observed in other transect (Shilaja, 1988).

There was a linear correlation between particulate and dissolved hydrocarbon concentration and chlorophyll (a), measurements ($r = 0.88$ and $r= 0.81$ respectively), suggesting that these hydrocarbons may be, at

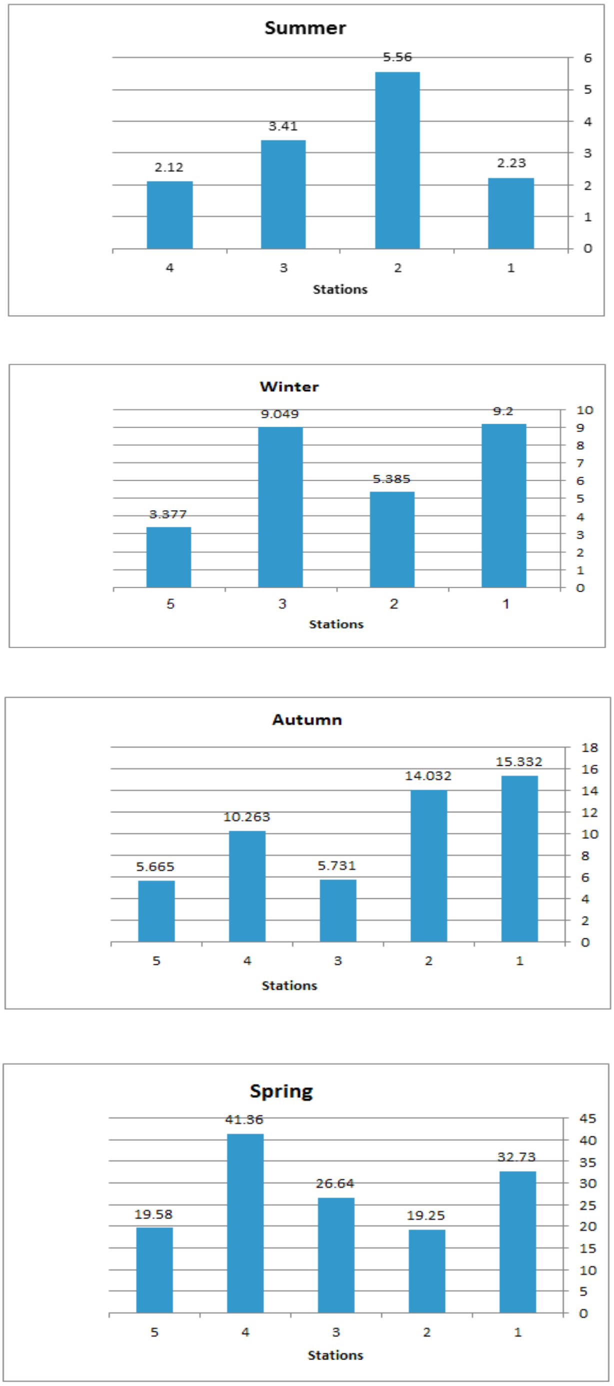

Figure 3. Distribution of TPHs (µg/l) in Bomba coastal lagoon.

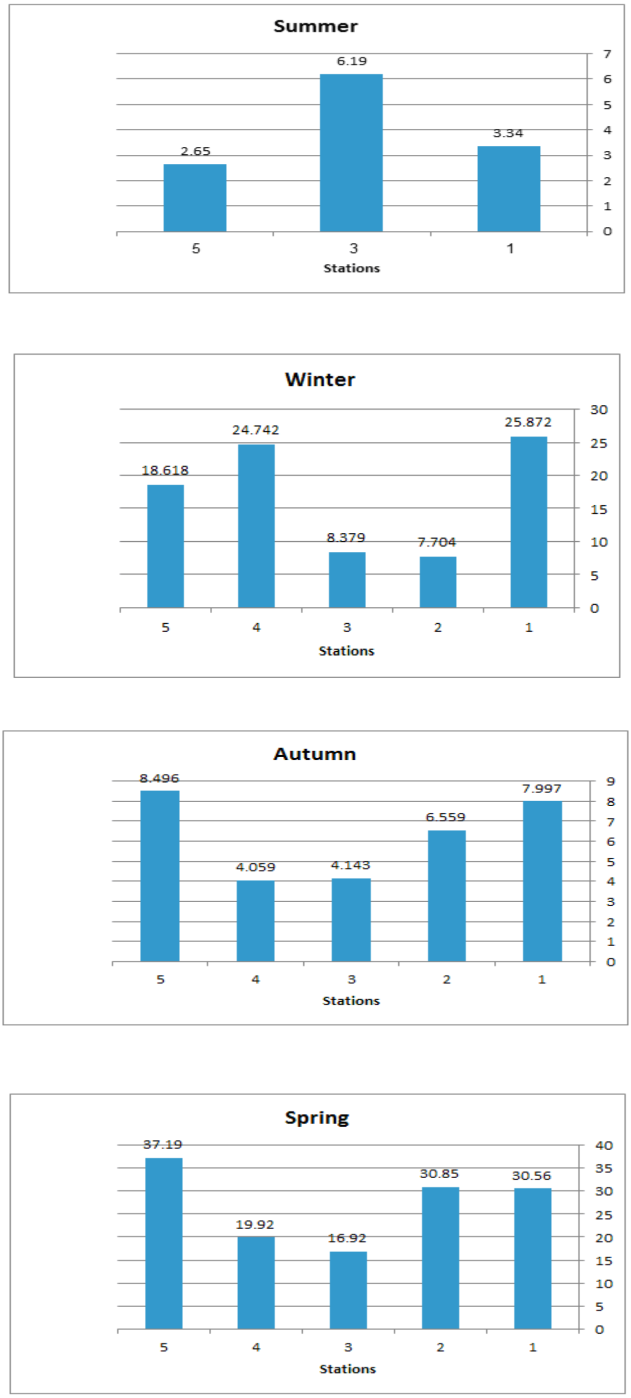

Figure 4. Distribution of TPHs (μg/l) in Katayta coastal lagoon.

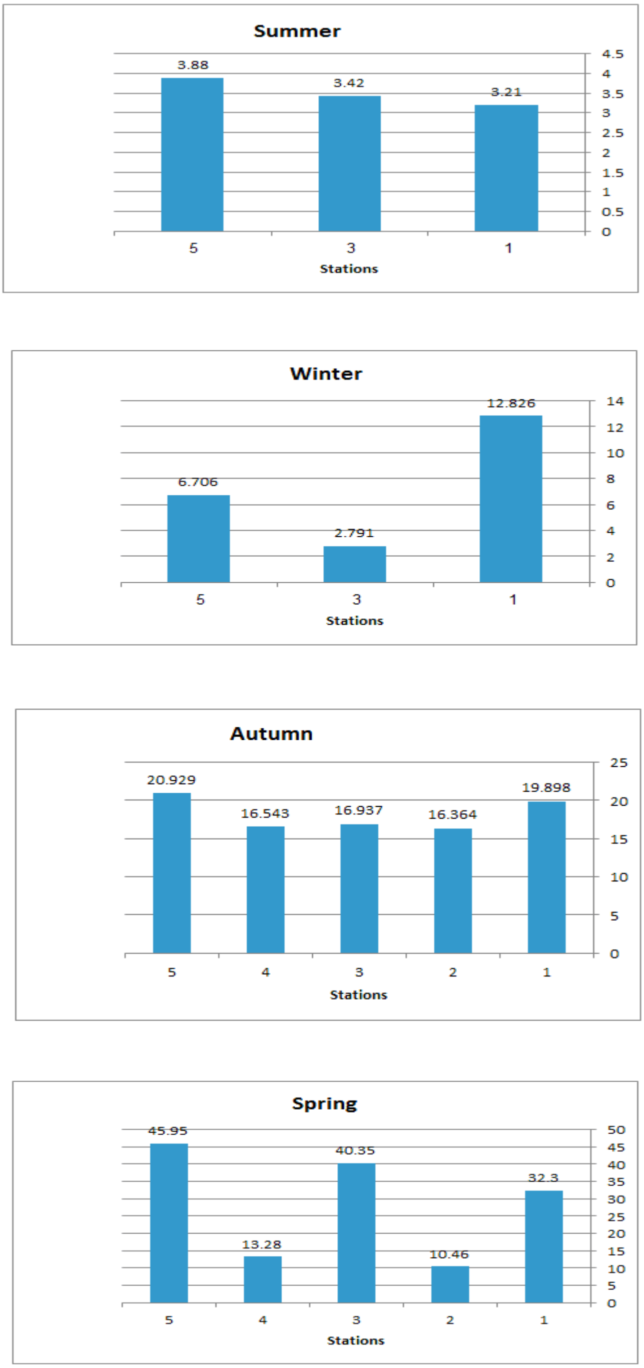

Figure 5. Distribution of TPHs (μg/l) from sampling in Bardia coastal lagoon.

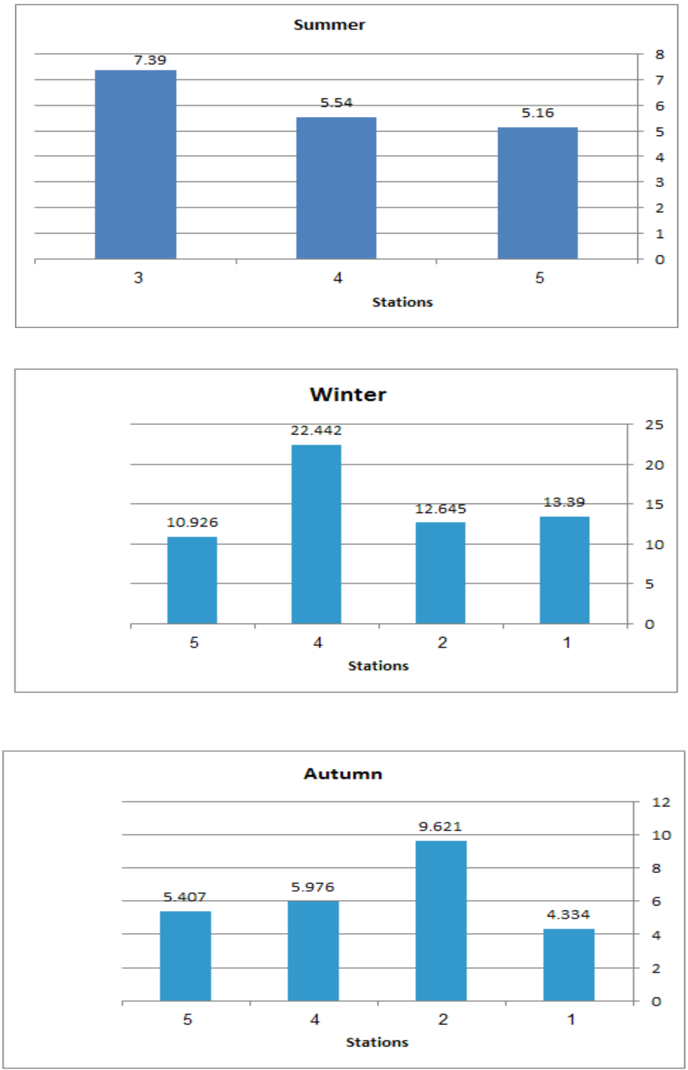

Figure 6. Distribution of TPHs (µg/l) in Um El-Shawish coastal lagoon.

Table 1. Average values of TPHs (µg/l) for some east coastal lagoons of Libya (July 1998-April 1999).

Lagoon	summer	winter	autumn	spring
Bomba	3.33	6.75	7.22	27.91
Katayta	4.09	8.38	6.25	27.09
Bardia	3.50	7.44	18.13	28.48
Um El-Shawish	7.19	10.93	6.33	------

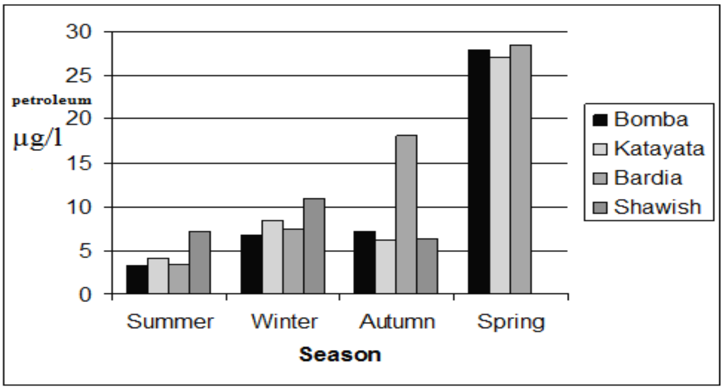

Figure 7. The seasonal variation of oil pollution for the studied coastal lagoons.

least, partially originated from biogenic sources (Al-Saad and Bedair, 1989). Concerning the level of dissolved/dispersed hydrocarbon the results are in accordance with those obtained by MFRC (1980) for Farwa lagoon, west of Libya. Relatively high values (>10µg/l) reflect the impact of external petroleum hydrocarbons sources on their distribution in sea waters, especially near petroleum terminals and in the area of shipping activities. The eastern part of Libyan coast classified as highly polluted (Greges and Durgham, 1983). It is recommend that oil pollution study in Libya start either in summer if it is limited or monthly for it is validity for comparison.

The data collected from the present study indicate that TPHs values were ranging from 3.3-28.48 ($\mu g I^{-1}$) ,by comparing them with TPHs recorded in different regions of the world ,the values lie within the range of recorded value for the different regions (Table 2).

Table 2. Total hydrocarbon levels ($\mu g I^{-1}$) in Sea water samples from different regions of the Mediterranean Sea.

Sites	PHs($\mu g I^{-1}$)	Reference
North sea	0.6-1.7	Law,*et.al.*(1987)
Halifax Harbouk	1.2-71.7	Michalik and Gordon(1971)
Eastern Mediterrean Sea-Turkey	4.16-100.93	Ozturk,*et.al.* (2007)
Cheda bucto Bay	1.0-90	Levy(1979)
Red Sea	138	Awad(1988)
Mediterrean Sea-Egypt(Alexandria)	6.7-9.8	O/WMO(1986)//UNEP
Libyan coast	24.9	Zsolnag(1979)
Syrte Gulf	10.11-16.60	Howage,*et.al.* (2000)
Spanish Coast	0.06-8.26	UNEP,(1988)
Mar Piccolo, Taranto, Italy	0.1-36	UNEP,(1988)
Libyan coast	0.6-28	Gerges and Durgham (1983)
Coastal water around Malta	0.02-0.29	UNEP,(1980)
Libyan coastal lagoons	3.3- 28.48	Present study

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دراسة مستويات متبقيات النفط في بعض البحيرات الساحلية شرق ليبيا

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المستخلص – تم دراسة التلوث النفطي في أربعة بحيرات ساحلية وهي بومبا، خطيطة، البردي وام الشاوش والتي تقع في الجزء الشرقي من ليبيا، موسميا للفترة من تموز1998 إلى ابريل 1999 في خمس محطات. وقد لوحظ أدنى مستوى من التلوث النفطي في الصيف في حين لوحظ أعلى مستوى في فصل الربيع. كان هناك وضوحا في التفاوت الموسمي الذي كان ينسب للظروف البيئية السائدة في هذه النظم البيئية الخاصة. وقد تم اعتماد طريقة التفلور لقياس التركيز الكلي للملوثات الهيدروكربونية TPHs حيث تراوح المستوى من 3.33 ميكروغرام/لتر في فصل الصيف الى 27.91 ميكروغرام/لتر في فصل الربيع في خليج البومبا، وفي خليج الخطيطة تراوح بين 4.09 ميكروغرام/لتر في الصيف الى 27.09 ميكروغرام/لتر في الربيع، وفي البردي من 3.50 ميكروغرام/لتر في الصيف إلى 28.48 ميكروغرام/لتر في الربيع، اما في ام الشاوش تراوح من 6.33 ميكروغرام/لتر في الخريف الى 10.93 ميكروغرام/لتر في فصل الشتاء. وقد تجاوزت بعض التراكيز 10 ميكروغرام/لتر، والتي قد تعطي مؤشر لتلوث الحياة البحرية في هذه البيئات.