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Ecological Status of the Seagrass Community in Sharm El-Moyia Bay (Gulf of Aqaba, Red Sea) after Oil Pollution in 1999

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Abstract. After four months of the oil pollution of Sharm El-Moyia Bay, the species composition, abundance, and distribution of seagrasses and associated macro-invertebrate fauna at oiled and non-oiled sites were investigated. The most abundant Seagrass, *Halophila stipulacea,* grows to a depth of 3 m on soft bottom substrates with standing crop ranging from 25 to 280 gdwm^{-2}. Leaf morphology and indicators of vegetative and sexual growth suggested that the meadow of this species at different sites of the bay is still healthy, despite being exposed to oil pollution. Biometric analyses indicated that the seagrass *Halophila stipulacea* was experiencing a seasonal transition and initializing a normal growth pattern from low winter temperature to spring conditions. Based on the field observations it is concluded that while oil pollution may lead to local destruction of macro-invertebrate fauna associated with the seagrass, it also did not cause any degradation to seagrass meadow. There is no conclusive evidence supports that oil floating above the seagrasses may damage them.

Key words: Oil pollution, Gulf of Aqaba, Red Sea, Seagrasses, Sharm El-Moyia Bay.

Introduction

Sharm El-Moyia Bay began to be polluted with oil from the end of 1998. At first, the source of pollution was unknown. But by August 1999, it was clear that the source of pollution was the diesel oil dumped in areas close to the shore during the transfer of old power plan from the southern-western region of the bay (Ras Mohamed Marine Park, personal communications). The oil continued to leak through rocks to the western water of the bay during 1999. At that time, huge amounts of oil were released into the bay. The touristic importance of the bay (where many luxury hotels) created concern among the authorities of Ras Mohamed Marine Park and Marine Sciences Department at Suez Canal University about this pollution, its effects and the possible treatment as well. As a result, the impact of oil spills and related environmental conditions were documented (Hanafy & Kotb, 1999). A large part of the oil accumulated along the western and southern-western shore of the bay, polluting the water and the sediment as well (Hanafy & Kotb, 1999). Within these shallow sub-tidal area reside productive seagrass community (Gab-Alla, 1996) which are favored habitats for many species of invertebrates and fish (Ahmed, 1992 and Gab-Alla, 1996).

This paper reports the results of the field work which examined the impact of the oil pollution on the ecology of the community of the seagrass *Halophila stipulacea,* the dominant species inhabiting Sharm El-Moyia Bay, and associated fauna as well.

Materials and Methods

Sampling was conducted during April 1999 in Sharm El-Moyia Bay, which is located on the western coast of the Gulf of Aqaba between Sharm El-Sheikh City and its harbour (Fig. 1). Eleven sites were fixed at different locations in the bay according to the survey done by the Marine Sciences Department of Suez Canal University in March 1999 (Hanafy & Kotb, 1999). These sites covered the entire area of the bay.

Pilot survey showed that the seagrass *Halophila stipulacea,* and the seaweed *Caulerpa racemosa* were the most spreading flora in the area of study. They were both or one of them representing the vegetation inhabiting the different sampling sites.

At each sampling site, temperature (glass mercury thermometer), salinity (refractometer), water's depth were recorded. Quantitative sampling of vegetation (seagrass and seaweed), as well as, semi-quantitative visual observations of the epiphytes and fauna of the seagrass were carried out.

The abundance of vegetation was quantified by three methods: 1) total biomass in grams dry weight per square meter ($gdwm^{-2}$), 2) density of *Halophila stipulacea* in shoots per square meter (sm^{-2}), and 3) a modified Braun-Blanquet Cover-abundance Scale (Braun-Blanquet, 1965).

Vegetation Density and Biomass

Samples of seagrass were obtained at each site by using 0.25 m^2 quadrat. To optimize the sampling process, four randomized samples were taken at each site (Kershow, 1980). Each sample consisted of all seagrass plant material with its roots and rhizomes to a depth of 15-20 cm in the substratum. After the quadrat was placed on the sea bottom, a knife was used to cut around its inside edge. This ensured that attached plant material outside the quadrat was not taken in the sample. Each quadrat was placed in a bag (5 mm mesh) and rinsed free of sediment. Macroscopic epiphytes (if present) were carefully scraped from the leaves, and the number of shoots were counted.

At sites where seaweed *Caulerpa racemosa* was present, its biomass was estimated by collecting all seaweed material in four replicates 1 × 1 m quardat. In the laboratory, the plant material was rinsed in 5% phosphoric acid, to digest adhering carbon materials, then placed in an oven at 60ºC and dried to a constant weight.

Braun-Blanquet Cover-abundance Scale

At each site, a minimum of four 0.25 m^2 (*Halophila stipulacea*), or four 1 m^2 (*Caulerpa racemosa*) quadrats were arbitrarily laid on the bottom. The seagrass or the seaweed occurring within the quadrats were assigned a cover-abundance scale value: 0.1- solitary, with small cover; 0.5- few, with small cover; 1) numerous, but less than 5% cover; 2) numerous, with 5-25% cover; 3) numerous, with 25-50% cover; 4) numerous, with 50-75% cover; 5) numerous, with more than 75% cover. Frequency of occurrence, abundance and density of the seagrass and seaweed were calculated by the following three formulae:

Frequency = no. of occupied quads/total no. of quads.
Abundance = sum of Braun-Blanquet scale values/no. of occupied quads.
Density = sum of Braun-Blanquet scale values/total no. of quads.

Statistical Analysis

Data of biometric parameters of the seagrass *Halophila stipulacea* (percentage cover, shoot density, and biomass); and seaweed *Caulerpa racemosa* (percentage cover and biomass) at polluted and non-polluted sites were statistically tested by analysis of variance (one-way ANOVA). Mean values were considered significant when $p < 0.05$.

Results

Environmental Conditions

In the water column of Sharm El-Moyia Bay, the salinity ranged from 41 to 43‰, and temperature from 24ºC to 26ºC at different sites (Table 1). The bay bottom is mainly sedimentary covered with fine sand at different sites except at the entrance where small patches of rocks and corals exist. These coral patches do not exceed 10 % cover of the rocky substrates.

Oil slicks were observed, floating over the water at the sites 2, 3, and 4. New man-introduced sandy

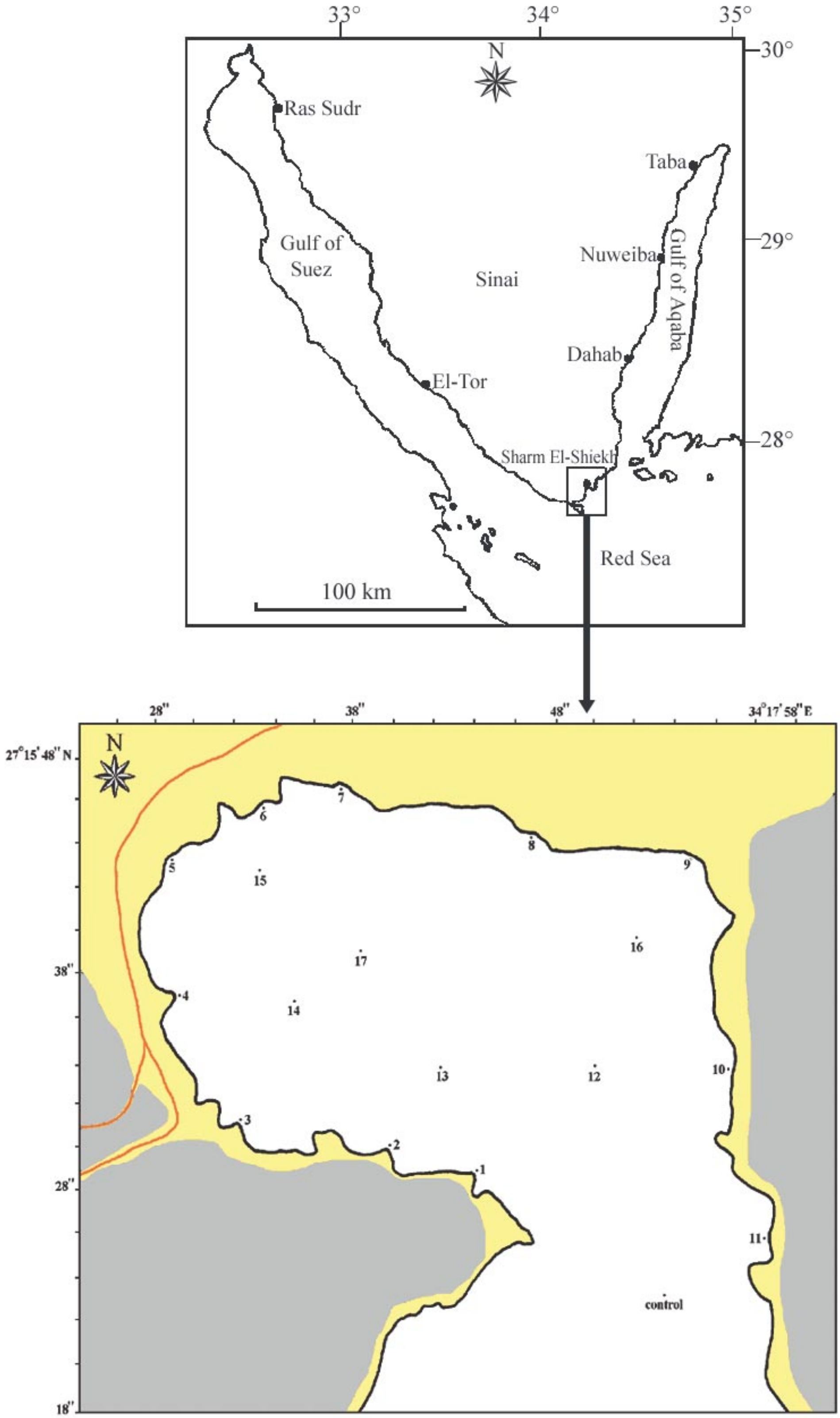

Fig. 1. A) Map of the Southern Sinai Peninsula showing the location of Sharm El-Sheikh. B) Locations of the sampling sites at Sharm El-Moyia Bay, after Hanafy & Kotb (1999).

TABLE 1. Status (oiled, non-oiled), water depth, temperature and salinity of different sampling sites of Sharm El-Moyia Bay. Note that position and status of the sites were detected according to Hanafy and Kotb (1999).

Site	Position	Status	Depth (m)	Temp. (ºC)	Salinity ‰
1	27º51′29"N 34º17′44"N	non-oiled	2	25 ± 2	42 ± 2
2	27º51′30"N 34º17′40"E	oiled	1.5	26 ± 1	42 ± 2
3	27º51′31"N 34º17′32"E	oiled	2	26 ± 1	43 ±1
4	27º51′37"N 34º17′29"E	oiled	2.5	24 ± 2	43 ± 1
5	27º51′43"N 34º17′29"E	non-oiled	1.5	24 ± 2	42 ± 2
6	27º51′45"N 34º17′33"E	non-oiled	1.5	24 ± 2	42 ± 2
7	27º51′46"N 34º17′38"E	non-oiled	2.5	25 ± 1	43 ± 2
8	27º51′44"N 34º17′47"E	non-oiled	2	25 ± 2	42 ± 1
9	27º51′43"N 34º17′55"E	non-oiled	1	26 ± 1	43 ± 1
10	27º51′34"N 34º17′57"E	non-oiled	1.5	26 ± 2	43 ±1
11	27º51′26"N 34º17′58"E	non-oiled	1.5	25 ± 2	43 ± 1

sediments were covering the shore (sites 5, 6, 7, and 8) in the front of resorts and extending to subtidal region of the bay.

Vegetation Density and Biomass

Three seagrass species *Halodule uninervis, H. ovalis,* and *Halophila stipulacea* were recorded during this survey. The most abundant species is *H. stipulacea.* It has a wide distribution at sites 1, 2, 3, 4, 9, 10, and 11 along the bay. The other two species *Halodule uninervis* and *H. ovalis* were restricted only to the intertidal region of the site 2 in a very localized strip, parallel to the shore, of 1-2 m wide. The seagrass meadow of *H. stipulacea* has a percentage cover ranging from 10% at sites 9, and 10; to 100% at site 2 (Table 2). The highest shoot densities of *Halophila stipulacea* was higher at the polluted site 2 than the clean site 1 (5000 and 4800 shoots m^{-2}, respectively). The lowest shoot densities occurred at sites 9, and 10 (non-oiled), where about 1000 shoots m^{-2} were recorded at each site (Table 2).

The seaweed *Caulerpa racemosa* was present in the sites 2, 3, 4, 5, 6, 7, and 8. Its percentage cover ranged from 30% to 100%. This cover was very high at the polluted area, representing 100%, 90%, and 70% at sites 2, 3, and 4, respectively. Nevertheless its percentage cover was 30%, 30%, 40%, and 70% at sites 6, 7, 8, and 5, respectively (Table 2).

The total biomass of *H. stipulacea* at the heavily oiled sites, ranged between 255 and 280 $gdwm^{-2}$, while, the biomass value of seagrass at the non-oiled site 1 was 270 $gdwm^{-2}$. The total biomass of the seaweed *C. racemosa* was higher in oiled sites than in non-oiled ones. The recorded biomass were 200,190, 125 $gdwm^{-2}$ at the oiled sites 2, 3, and 4, whereas it was 130, 45, 30, and 50 $gdwm^{-2}$ at sites 5, 6, 7, and 8, respectively.

TABLE 2. Biometric parameters of seagrass *Halophila stipulacea* and seaweed *Caulerpa racemosa* at different sampling sites of Sharm El-Moyia Bay. *Stations 1-4: Climax seagrass community; #Stations 9-11: New growing seagrass community.

Species	Sites										
	1*	2*	3*	4*	5	6	7	8	9#	10#	11#
Halophila stipulacea											
Percentage cover	98 ± 2	100 ± 0	85 ± 5	80 ± 5	–	–	–	–	10 ± 2	10 ± 2	15 ± 5
Shoot density (No. of shoots m^{-2})	4800 ± 200	5000 ± 300	4500 ± 100	4500 ± 100	–	–	–	–	1000 ± 50	1000 ± 40	1200 ± 100
Total biomass (D wt m^{-2})	270 ± 30	280 ± 30	260 ± 25	– ± 25	–	–	–	–	30 ± 5	25 ± 3	27 ± 3
Caulerpa racemosa											
Percentage cover	–	100 ± 0	90 ± 7	70 ± 5	70 ± 6	30 ± 5	30 ± 4	40 ± 6	–	–	–
Total biomass (D wt m^{-2})	–	200 ± 40	190 ± 30	125 ± 25	130 ± 20	45 ± 10	30 ± 5	50 ± 15	–	–	–

The difference between percentage cover, shoot density, and biomass for the seagrass *Halophila stipulacea* at site 1 and site 2 was not statistically significant ($p > 0.05$). Also, there was no obvious difference between percentage cover and biomass of the seaweed *Caulerpa racemosa* at site 4 and site 5 ($p > 0.05$). Other non-polluted sites showed significant difference from the polluted sites ($p < 0.05$), which may be attributed to the suitable environmental conditions at the west and south-west of the bay, leading to high biometric data for *H. stipulacea* and *C. Racemosa* at the polluted sites.

Braun-Blanquet Cover-abundance

According to Braun-Blanquet cover-abundance scale (Table 3), the seagrass *H. stipulacea* occurred with the highest frequency, abundance and density both at the oiled sites 2, 3, and 4, and non-oiled site 1; while, at other sites 9, 10, and 11, the seagrass with less abundance and density was highly frequent. The seaweed *Caulerpa racemosa* was relatively frequent, dense and abundant at the polluted sites, than the non-oiled ones. Comparing the non-oiled site 1, with the oiled sites 2, 3 and 4 suggests that there is no oil related impact on the seagrass distribution, frequency, density, abundance (Table 3), or biomass (Table 2). The complete absence of seagrasses from sites 5, 6, 7, and 8 is possibly due to the presence of unstable sediments covering the coast, which is unsuitable for the development of these plants.

Other Ecological Aspects

The Seagrass community at the sites 9, 10, and 11 was growing newly (after wintering), and consisted of delicate sparse shoots with normal new leaves, and male and female flowers. Recently grown rhizome apical meristems and central branches were also developing.

The leaves of the investigated seagrass species were nearly free from epiphytes. The microscopic examination showed very clean leaves in most cases. The algal epiphytes *Rivularia polyotis* and *Polysiphonia* sp. were rarely recorded on the leaves of seagrass *Halodule uninervis* (site 2), and *Halophila stipulacea* (sites 1&2).

Invertebrate fauna of the seagrass community was less diverse in the oiled sites compared with the non-oiled site 1 (Table 4). Seven species were recorded at oiled sites, while 21 species were recorded at non-oiled one. The most common species were the gastropods *Conus arenatus, C. tessulatus, Strombus gibberulus, S. mutibilis* at the oiled sites 2, 3, and 4, while the species, *Botula cinnamomea,* and *Cerithium rupelli, Pinna muricata, Strombus gibberulus,* and *S. mutibilis* were commonly recorded at non-oiled site 1.

Discussion

Three species of seagrasses *Halodule uninervis, Halophila ovalis,* and *Halophila stipulacea* known to occur in Sharm El-Moyia Bay (Gab-Alla, 1996),

TABLE 3. Summary of Braun-Blanquet data on frequency of occurrence, density and for Seagrass *Halophila stipulacea* and seaweed *Caulerpa racemosa* from oiled and non-oiled sites at the El-Moyia Bay.

Status / site	*Halophila stipulacea*			*Caulerpa racemosa*		
	Frequency	Abundance	Density	Frequency	Abundance	Density
oiled						
2	1.00	5.00	5.00	1.00	5.00	5.00
3	1.00	5.00	5.00	0.75	5.00	3.75
4	1.00	5.00	5.00	0.50	4.00	2.00
non-oiled						
1	1.00	5.00	5.00	–	–	–
5	–	–	–	0.75	4.00	3.00
6	–	–	–	0.50	3.00	1.50
7	–	–	–	0.50	3.00	1.50
8	–	–	–	0.25	3.00	0.75
9	1.00	2.00	2.00	–	–	–
10	1.00	2.00	2.00	–	–	–
11	1.00	2.00	2.00	–	–	–

TABLE 4. A list of invertebrate species of seagrass community (oiled, non-oiled) at Sharm El-Moyia Bay during the present study. (–) Absent; (+) Present: < 1 individual / m^2; (++) Common: > 4 individuals/m^2.

Species	Oiled sites	Non-oiled sites
Mollusca		
Anadara antiquata Linnaeus	–	+
Botula cinnamomea Lamarck	–	++
Cerithium rupelli Philippi	+	++
Circe calipyga Born	–	+
Circe corrugata Dillwyn	–	+
Conus arenatus Hwass im Bruguiere	++	+
Conus tessulatus Born	++	+
Glycymeris pectunculus Linnaeus	–	+
Muricodrupa fiscellum Gmelin	–	+
Nassarius concinnus Powys	–	+
N. protrusidens Melvill	–	+
Natica gualteriana Recluz	–	+
Pinna muricata Linnaeus	–	++
Strombus fasciatus Born	–	+
Strombus gibberulus Morch	++	++
Strombus mutibilis Swainson	++	++
Strombus tricornis Humphery	+	–
Crustacea		
Alphus sp.	–	+
Clibanarius sp.	+	+
Paracleistostoma sp.	–	+
Echinodermata		
Tripeneustis gratilla Linnaeus	–	+
Polychaeta		
Notopygos veriabilis Potts	–	+
Total number of species	7	21

were investigated during the present work, where the west and south-west of the bay became heavily oiled according to Hanafy & Kotb (1999). Based on the frequency of occurrence, biomass and density analyses, *Halophila stipulacea* is the most common seagrass in this bay, while the other two species *Halodule uninervis* and *H. ovalis* are very rare and restricted only to site 2.

The density and biomass of the seagrass *Halophila stipulacea* and the seaweed *Caulerpa racemosa* in the oiled sites were comparable to non-oiled ones, and pre-pollution conditions previously described for this bay (Gab-Alla, 1996). Shoot density of *Halophila stipulacea* at site 2 exceeded (5000 m^{-2}) the non-oiled meadow of the same species at site 1 at the same time (4800 m^{-2}) or during 1996 (3712 m^{-2}). In a study by Kenworthy *et al.* (1993) along the north eastern Saudi Arabian shore, after the Gulf War oil spill, they observed that shoot densities were similar to, or exceeded, non-oiled meadows of the same species in the Gulf of Aqaba (Wahbeh, 1984) and Australia (Larkum *et al.*, 1989). The range in seagrass biomass (25-280 gdwm^{-2}) during this study was wider than that previously recorded by Gab-Alla (1996) in this bay (35-135 gdwm^{-2}). As well, the range in algal biomass of *Caulerpa racemosa* in this study (30-200 gdwtm^{-2}) was wider than that previously recorded by Gab-Alla in 1996 (5-30 gdwtm^{-2}). This may be attributed to the suitable environmental conditions at the west and south-west of the bay, *e.g.* stable bottom, low current regime, high organic matter content, high transparency and low suspended matter.

Unfortunately, many studies stress on seagrass biomass and productivity while neglect to report on shoot density, which may be a more relevant indicator for assessing the ecological status of seagrasses. Seagrass biomass (especially standing crop) usually displays a large seasonal fluctuation when experiencing different ambient temperatures and light regimes (Kenworthy, 1992). The densities of *H. stipulacea* (climax community) observed at the heavily oiled sites resembled the relatively healthy seagrass bed (site 1) of the same species in the bay. These findings are in agreement with that of many authors (Eleuterius, 1987; Fonseca *et al.,* 1987; Pangallo and Bell, 1988; Kenworthy, 1992; Kenworthy *et al.*, 1993; Gab-Alla, 1996).

Qualitative observations revealed that all the recorded species were exhibiting good growth characteristics. New leaves were emerging and recently initiated rhizome apical meristems and lateral branches were also developing. Flowering was recorded in *Halophila stipulacea* which means that it is completing its life history under these conditions. Both sexual and asexual reproduction was also observed. However, this seagrass is known worldwide for rapid asexual reproduction (Fonseca *et al.*, 1987; Posluszny & Tomlinson, 1990), as well as sexual reproduction (Josselyn *et al.*, 1986; McMilllan, 1988a,b). It has the ability to establish its population from seeds or vegetative fragments (Mcmillan, 1988b; Williams, 1988; Larkum *et al.*, 1989; Kenworthy, 1992).

In the southeastern United States shores and in some areas of the Caribbean, *H. decipiens* recovers after seasonal and climatic perturbations almost exclusively by seed. *Halodule* and *Halophila* form overwintering, or even longer term, seed banks which could re-establish seagrass populations in environmentally or anthropogenically impacted sites. In Australia, *H. uninervis* and *H. ovalis* often represent the primary colonizing species and they initiate the recovery of seagrasses in areas impacted by cyclones and other natural or man-induced perturbations (Poiner *et al.*, 1989; Clarke & Kirkman, 1989). Shepherd *et al.* (1989) confirmed that localized loss of seagrass at Cockburn Sound Bay in Australia detected after 7 years of discharge from oil refinery, and the commencement of rapid decline of the meadow after 14 years of discharge. Effluent from the oil refinery enters the bay was supplied to seagrass in aquaria, to test the possibility that it may have caused widespread losses of seagrasses (Cambridge *et al.*, 1986). The plants proved rather insensitive to effluent. A significant reduction in growth only occurred at a concentration of hydrocarbons equivalent to that entering the bay, before extensive dilution by the waters of the bay.

Seedling recruitment recorded at different sites means that the seagrass bed is in the stage of maintenance and recovery in the east, west, and south west of the bay, while at the north the bay is still suffering a more stressful environmental conditions. The presence of unconsolidated moving sediments, probably limits the overall distribution and abundance of seagrasses in this area of the bay.

The macro-invertebrate fauna at oiled sites was obviously affected in terms of decreased invertebrate diversity. Loya and Rinkevich (1980) stated that oil pollution usually kills and causes serious damages to the different macro-invertebrates.

Briefly speaking, the present status of seagrass in Sharm El-Moyia Bay suggests that it is not experiencing any degradation due to the oil pollution of the bay. Qualitative and quantitative observations on the distribution, abundance, biomass, seedling recruitment and reproduction support the current conclusion that the seagrass itself was not experiencing a measurable impact from oil pollution in this bay during 1999, while macro-invertebrate fauna showed distorted community with low diversity.

References

Ahmed, A.I. (1992) *Ecological and biological studies on juveniles fishes in South Sinia.* M.Sc. Thesis. Suez Canal University, Egypt.

Braun-Blanquet, J. (1965) *Plant Sociology: The study of plant communities* (Fuller, CD & Conard HS, Eds.). Hafner, London, 431p.

Cambridge, M. L., Chiffings, A.W., Brittan, C., Moore, L. and **McComb, A.J.** (1986) The loss of seagrass in Cockburn Sound, Western Australia. II. Possible causes of seagrass decline. *Aquat. Bot.,* **24:** 269-285.

Clarke, S.M. and **Kirkman, H.** (1989) Seagrass dynamics. In: *Biology of Seagrasses: A Treatise on the Biology of Seagrasses with Special Reference to the Australian Region* (Larkum, A. W. D.; McComb, A. J. and Shepherd, S. A., Eds.). Elsevier, New York, pp. 304-345.

Eleuterius, L.N. (1987) Seagrass ecology along the coasts of Alabama, Louisiana, and Mississippi. *Fla. Mar. Res. Publ.,* 42: 11-24.

Fonseca, M.S., Thayer, G.W. and **Kenworhty, W. J.** (1987) The use of ecological data in the implementation and management of seagrass restorations. *Fla. Mar. Res. Publ.,* **42:** 175-188.

Gab-Alla, A. A-F.A. (1996) *Ecological studies on the seagrass communities of Southern Sinai (Red Sea).* Ph.D. Thesis. Suez Canal University, Egypt.

Hanafy, M.H. and **Kotb, M.A.** (1999) *Environmental assessment for the Bay of Sharm El-Moyia, South Sinai, Egypt*. Report to EEAA. 150pp.

Josselyn, M., Fonseca, M., Niesen, T. and **Larson, R.** (1986) Biomass, production and decomposition of a deep water seagrass *Halophila decipiens.* Ostenf. *Aquat. Bot.,* **25:** 47-61.

Kenworthy, W.J. (1992) *Protecting fish and wildlife habitat through an understanding of the minimum light requirements of subtropical-tropical seagrasses of the southeastern United States and Caribbean Basin.* Ph.D. Dissertation, North Carolina State University, Raleigh, NC 258 p.

Kenworthy, W.J., Durako, M.J., Fatemy, S.M.R., Valvi, H. and **Thayer G.W.** (1993) Ecology of seagrasses in Northeastern Saudi Arabia one year after the Gulf War oil spill. *Mar. Poll. Bull.,* **27:** 213-222.

Kershaw, K.A. (Ed.) (1980) *Quantitative and Dynamic Plant Ecology.* Edward Arnold: London.

Larkum, A.W.D., McComb, A.J. and **Shepherd, S.A. eds.** (1989) *Biology of Seagrasses. A Treatise on the Biology of Seagrasses with Special Reference to the Australian Region.* Elsevier, New York, 841p.

Loya, Y. and **Rinkevich, B.** (1980) Effects of oil pollution on coral reef communities. *Mar. Ecol. Prog. Ser.,* **3:** 167-180.

McMillan, C. (1988a) The seed reserve of *Halophila decipiens* Ostenfeld (Hydrocharitaceae) in Panama. *Aquat. Bot,.* **31:** 177-182.

McMillan, C. (1988b) Seed germination and seedling development of *Halophila decipiens* Ostenfeld (Hydrocharitaceae) in Panama. *Aquat. Bot.,* **31:** 169-176.

Pangallo, R.A. and **Bell, S.S.** (1988) Dynamics of the aboveground and belowground structure of thre seagrass *Halodule wrightii. Mar. Ecol. Prog. Ser.,* **43:** 297-301.

Poiner, I., Walker, D.I. and Coles, R.G. (1989) Regional studies-seagrasses of tropical Australia. In: *Biology of Seagrasses. A Treatise on the Biology of Seagrasses with Special Reference to the Australian Region* (Larkum A. W. D.; McComb, A. J. and Shepherd, S. A., eds.). Elsevier, New York, pp. 279-303.

Posluszny, U. and Tomlinson, P.B. (1990) Shoot organization in the seagrass *Halophila* (Hydrocharataceae). *Can. J. Bot.,* **69:** 1600-1615.

Shepherd, S.A., McComb, A. J., Bulthuis, D. A., Neverauskas, V., Steffensen, D.A. and **West, R.** (1989) Decline of seagrasses. *In: Biology of Seagrasses. A treatise on the biology of seagrasses with special reference to the Australian region.* (Larkum, A. W. D.; McComb, A. J. and Shepherd, S. A., eds.). Elsevier, New York, pp. 346-393.

Wahbeh, M. I. (1984) The growth and production of the leaves of the seagrass *Halophila stipulacea* (Forsk.) Aschers. from Aqaba, Jordan. *Aquat. Bot.,* **20:** 33-41.

Williams, S.L. (1988) Disturbance and recovery of a deep water Caribbean seagrass bed. *Mar. Ecl. Prog. Ser.,* **42:** 63-71.

الحالة البيئيـة لمجتمـع الأعشاب البحريـة في جونـة شرم الميـة بساحل خليج العقبة – البحر الأحمر بعد التلوث البترولي في ١٩٩٩

علي عبد الفتاح علي جاب اللّه

قسم علوم البحار ، كلية العلوم ، جامعة قناة السويس ، الإسماعيلية – جمهورية مصر العربية

المستخلص. خلال فترة التلوث البترولى لشرم المية عام ١٩٩٩ ، تم دراسة التركيب النوعى وكثافة كل من الحشائش واللافقاريات البحرية فى مناطق مختلفة « ملوثة وغير ملوثة بالبترول » فى جونة شرم المية . حيث وجد أن أكثر الحشائش انتشاراً وكثافة هو الهالوفيلا استيبولاسا الذى ينمو بعمق ١–٣ متر على التربة الرسوبية لهذه الجونة . وقد تراوح المحصول القائم ما بين ٢٥–٢٨٠ جرام كتلة جافة/ م٢ . ولقد أوضح الشكل الظاهري وعلامات النمو الجنسي « التزهير » أن حقول هذا النوع من الحشائش فى المناطق المختلفة من الجونة صحية ولم تتأثر بالتلوث البترولي وتنمو بطريقة عادية . ولهذا اعتماداً على هذه المعلومات فلقد أشار البحث إلى أن النباتات المكونة لمجتمع الحشائش البحرية بشرم المية لم تعاني أي تدهور نتيجة للتلوث البترولي الذي حدث ، بينما أظهرت اللافقاريات القاطنة له تدهوراً في التركيب النوعي والكثافة .