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ECOLOGICAL STUDIES ON COMMERCIAL SPONGES IN WEST OF ALEXANDRIA

A.M. KHEIRALLAH*, H.K. BADAWI** AND M.M EL-BESHBESHY**

* Zoology Department, Faculty of science, Alexandria university.

** National Institute of Oceanography and Fisheries, Alexandria.

ABSTRACT

Samples were taken during sponge fishing season from four regions in an area extending 190 km along the western Mediterranean coast of Alexandria to determine the abundance of the three commercial sponge types namely Turkey cup, Honey comb and Zimocca and to evaluate the correlations of their abundance with the main environmental factors. The regions studied were at El-Hammam denoted "A", El-Alamein "B", Fukah "C" and Matrouh "D". Variations in the total of the mean numbers of the three sponge types were noticeable among the different regions. El-Hammam region supported more populations than the other regions. There were also variations in population densitites of each commercial sponge type in the different regions. Turkey cup tended to decrease towards the western side while Honey comb and Zimocca exhibited fluctuations in density along the area investigated.

The study of the environmental factors prevalent in the area investigated revealed that high concentrations of phytoplankton, large surface area of rocky and consolidated substrata and high production of sea grasses and green algae are important in controlling the abundance of commercial sponges. Novertheless, temperature, salinity, concentration of zooplankton and percentages of organic and carbonate contents of the bottom sediments yielded no significant correlation with sponge abundance indicating that these factors are not of primary importance in controlling the abundance of commercial sponges in the area investigated.

INTRODUCTION

Studies on the ecology of Egyptian commercial sponges received little attention. Paget (1923), Jenkins (1926), Fouad (1927 & 1928), Wimpenny (1931), McDonald (1932), Fouzi (1933, 1936 & 1938) and Samra (1935) gave an account of the abundance of the three commercial sponges namely Turky cup, Honey comb and Zimocca in an area west of Alexandria from Ras El-Agami to Abu Darash.

The present paper aims to achieve a complementary ecological knowledge about these commercial sponges in an area of approximately 190 km along the western Mediterranean coast of Alexandria from El-Hammam to Mersa Matrouh. Attention was focused on population density and distributional behaviour of the three commercial sponge types in relation to the main environmental factors.

MATERIAL AND METHODS

A- The Investigated Area:

The study area covers the region west of Alexandria from El-Hammam to Mersa Matrouh (Fig. 1). It extends about 190 km along the western Mediterranean coast of Alexandria, and it lies between longitudes 29° 21′ and 27° 10′.

Four regions were chosen for sampling sponges within the continental shelf. These regions were at El-Hammam, El-Alamain, Fukah and Matrouh. For simplicity, these regions are denoted A, B, C and D from east to west, respectively. Regions A and B lie about 2-8 km from the sea shore, whereas regions C and D lie about 2-5 km from the sea shore.

B- Nature of the Bottom:

The area investigated comprises different types of bottom deposits. These deposists lie at a depth which varies from 10-50 m. The deposits vary from coarse sand in the western regions to coarse gravels and fine sand in the eastern regions. Regions A, B, C and D exhibit two main types of solid substrata necessary for sponge settling. These are rocky substratum and consolidated substratum. The latter (plate 1 a and b) is constructed by the action of the living organisms. Each substratum is covered with the sea grasses Zostera sp. and Posidonia sp. in addition to the green algae Caulerpa prolifera which is characteristic for commercial sponge beds. There is also a third substratum in the form of Moulluscan shells (plate 1c).

C- Sampling Technique:

Samples were taken from the different regions in 1981 by using Fernez apparatus during sponge fishing season which began in May and continued to November.

Preliminary samples showed that sponge populations were confined to the solid substrata (rocky and consolidated substrata). Sampling was accordingly restricted to such places.

From region A, 17 sample units were taken from an area of 48 km^2 (6 x 8 km). From regions B and D, 14 sample unites were taken from an area of 45 km^2 (9 x 5 km) and 50 km^2 (10 x 5 km) respectively. From region C, 33 sample units were taken from an area of 44 km^2 (11 x 4 km). Samlpes were taken on a random basis. The area of each sample unit is 1 km^2 and was taken to a depth varying from 18 to 40 m.

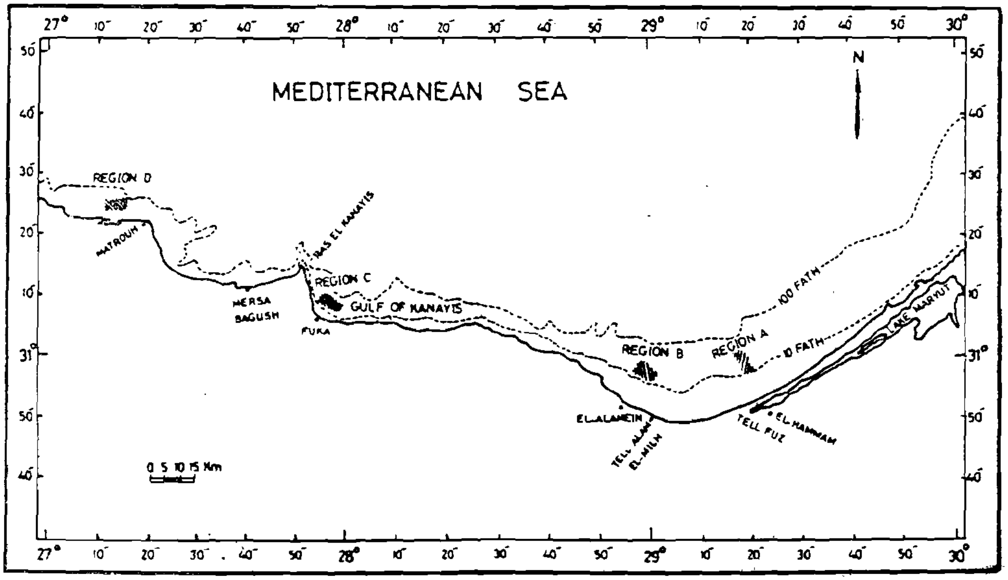

FIG. 1.
The area investigated; positions of the four regions sampled during 1981

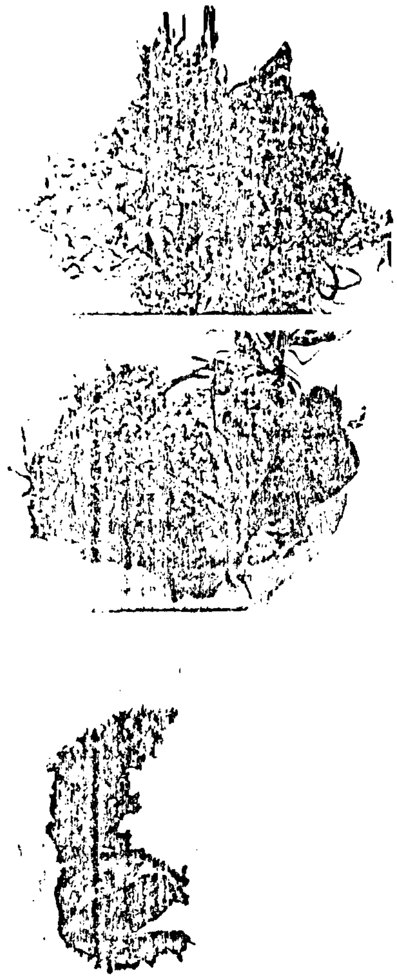

Plate 1
Solid substrata for sponge settling: (a) and (b) consolidated substratum constructed by the action of living organisms; (c) substratum formed by molluscan shells

The sponge specimens were collected by pulling them from the solid substrata. They were then placed in a basket and lifted up to the ship by a cord. The commercial specimens were selected from the catch on the fishing boat and numerical tags were attached to them.

D- Determination of the Organic Contents of the Bottom Sediments:

Organic contents of the bottom sediments in regions A, B, C and D were determined by direct method described by El-Wakeel and Riley (1957).

E- Determination of the Carbonate of the Bottom Sediments:

Carbonate contents of the sediments in regions A,B,C and D were determined according to Shata (1979).

F- Determination of Temperature:

Measurements of temperature in regions A, B, C and D at depth of catching were made with the standard reversing protected thermometers.

G- Determination of Salinity:

Measurements of salinity in regions A, B, C and D at depth of catching were made using a Beckman Iduction Salinometer (Model Rs-7B).

H- Determination of Phytoplankton and Zooplankton:

Concentrations of phytoplankton and zooplankton in regions A, B, C and D were quoted from Anon. (1979).

RESULTS

1- Population Density of the Three Commercial Sponge Types:

The mean number of individual sponges belonging to the three commerical types which were collected from each region are given in Table 1. It is clear from the table that there are fluctuations in the mean population densities of the three commercial sponge types within each region and in different regions. Significant differences in the mean population density were observed between Turkey cup, Honey comb and Zimocca in region A, whereas the difference between Honey comb and Zimocca was not significant ($t=0.35$, $p> 0.1$). In region B, the mean population density of Turkey cup differs highly and significantly from the mean population density of either Honey comb or Zimocca, and there is also a high significant difference between the mean population densities of Honey comp and Zimocca. In region C, a similar trend in density change can be observed between Tukey cup, Honey comb and Zimocca. In region D, the mean population density of Honey comb was significantly higher than the mean population density of either Turkey cup or zimocca.

TABLE .1.

population density of the three commercial sponge types in each region (Km^2) with standard error. Sample size in round brackets. the lower figures indicate range.

Region	Date of sample	Mean population density/km^2 (±S.E.)			Total of the mean numbers
		Turkey cup	Honey comb	Zimocca	
EL-Hammam (A)	18-21 June, 1981	55.7±3.54(17)$^{***+++}$ 30---56	26.5±4.43(17) 11---54	17.3±3.39(17) 9---23	99.50
EL-Alamain (B)	8-11 August, 1981	20.1±2.14(14)$^{***+++}$ 8---30	10.1±0.89(14)^{ooo} 5---6	5.4±0.8 (14) 1---8	35.60
Fukah (C)	18-21 Sept., 1981	21.9±1.14(33)$^{**+++}$ 10---32	18.1±1.01(33)^{ooo} 9---35	12.4±1.78(33) 5---30	52.40
Matrouh (D)	20-24 Oct., 1981	15.6±1.36(14)*** 9---27	34.2±2.33(14)^{ooo} 16---41	14.7±2.04(14) 6---25	64.50

Differences in the mean population densities of Turkey cup and Honey comb within each region were tested for significance using "student's" t,**p<0.01, **p<0.001, as were the mean population densities of Turkey cup and Zimocca, +++p<0.001 and the mean population densities of Honey comb and Zimocca, ^{ooo}p<0.001.

Nevertheless, the mean population densities of the two latter sponge types was not significantly different from each other.

Again significant differences in the mean population densities of the three sponge types were observed between the different regions. Turkey cup differed significantly between regions A and B (t=8.1, p< 0.01); A and C (t=11.3, p< 0.001); A and D (t=9.7, p< 0.001); and C and D (t=3.1, p< 0.01) but the difference was not significant between regions B and C (t=0.8, p> 0.4); and B and D (t=1.77, p> 0.1). Honey comb differed significantly between regions A and B (t=3.4, p< 0.01); A and C (t=2.44, p< 0.05); B and D (t=9.9, p< 0.001); B and C (t=5.19,p< 0.001); and C and D (t=7.47, p< 0.001), whereas the difference was not significant between regions A and D (t=1.45, p> 0.05). Zimocca differed significantly between regions A and B (t=3.1, p< 0.01); B and C (t=3.68, p< 0.001); and B and D (t=4.24, p< 0.001), while it was not significant between regions A and D (t=0.16, p> 0.5); A and C (t=1.67, p> 0.05); and C and D (t=1.03, p> 0.05).

Generally speaking, Turkey cup tended to decrease towards the western side while Honey comb and Zimocca exhibited fluctuations in density along the area investigated. Again region A harboured more commercial sponge than the other three regions (Fig. 2).

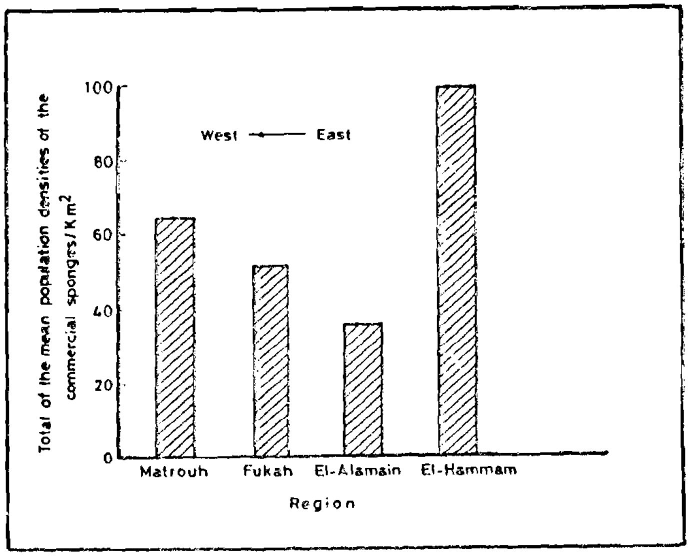

FIG. 2.
Total of the mean population density of the three commercial sponge types in each region

2- Analysis of the Distributional Behaviour of the Three Commercial Sponge Types in Relation to the Different Environmental factors:

The distributional behaviour of the three commercial sponge types in relation to the main environmental factors, mainly temperature, salinity , percentages of organic and carbonate contents of the bottom sediments and concentrations of phytoplankton and zooplankton were studied in the four regions. Variations in each of these environmental parameters were correlated with the total of the mean population densities of the three commercial sponge types (Table 2). It can be seen from the table that the total of the mean densities of the three sponge types varies significantly along gradients of phytoplankton. There is a gradual change in densities along gradients of this factor. In fact, higher densities are associated with high levels of phytoplankton. The degree of correlation between the concentration of phytoplankton and total of the mean densities of the three commercial sponge types was evaluated ($r=0.99095$, $p< 0.05$). However, total of the mean densities of the three commercial sponge types along gradients of temperature, salinity, percentages of organic and carbonate contents and concentration of zooplankton yielded no significant correlation. In all cases $p> 0.1$ which indicates that these factors are not of primary importance in controlling the distributional behaviour of the three commercial sponge types in the area investigated.

TABLE .2.

Total of the mean population densities of the three commercial sponge types along gradients of environmental factors.

Region	El-Hammam (A)	El-Alamain (B)	Fukah (C)	Matrouh (D)	Value of r	Value of P
Total of the mean population densities of the three commercial types (individuals/km^2).	[illegible]	35.60	52.40	[illegible]		
Environmental factors.						
Average seasonal temperature(^{o}C)at depth of catching.	[illegible]	21.76	21.93	20.65	0.0417	>0.1 insignificant
Average seasonal salinity(%)at depth of catching.	38.95	38.81	38.78	38.72	0.6755	>0.1 insignificant
Organic contents (%) of the bottom sediments.	0.51	0.52	0.61	0.69	-0.158	>0.1 insignificant
Carbonate contents (%) of the bottom sediments.	96.285	98.42	98.81	99.37	-0.737	<0.1 insignificant
Phytoblankton cell/l.	19474	1958	1945	2022	0.90095	<0.05 significant
Zooplankton organisms/m^3.	3714	1989	1483	1656	0.8167	<0.1 insignificant

DISCUSSION

The largest numbers of the commercial sponge types were found in the region of El-Hammam (region A) which supported a total of the mean number of 99.5 individuals / km^2, followed by the region of Matrouh (region D) which supported a total of the mean numbers of 64.5 individuals / km^2 then by the regions of Fukah (region C) and El-Alamain (region B) which supported a total of the mean numbers of 52.4 and 35.6 individuals / km^2, respectively.

There were also fluctuations in population densities of each commercial sponge type in the different regions. Turkey cup was more abundant in the region of El-Hammam which supported a mean population density of 55.7 individuals / km^2. Density decreased towards the eastern side untill it reached a minimum at Matrouh where the mean population density was 15.6 individuals / km^2. Honey comb was more abundant in the region of Matrouh which supported a mean population density of 34.2 individuals / km^2. Density decreased towards the eastern side until it reached a minimum at El-Alamain where the mean population density was 10.1 individuals/ km^2. Zimocca was more abundant in the region of El-Hammam which supported a mean population density of 17.3 individuals / km^2. Its density reached a minimum at El-Alamain where the mean population density was 5.4 individuals / km^2. Density then increased towards the western side. In general, density of Turkey cup decreased towards the western side while Honey comb and Zimocca exhibited fluctuations in density along the area investigated. Honey comb attained its highest density at the region of Matrouh whereas Zimocca attained its highest density at El-Hammam.

Preliminary work on the abundance of the three commercial sponge types in west of Alexandria from Ras El-Agamy to Martrouh was that of Paget (1923), Jenkins (1926), Fouad (1927 & 1928), Wimpenny (1931), McDonald (1932) and Fouzi (1933). They showed that the total catch of the three commercial sponges was higher in the region which extends from Ras El-Agami to Ras Sheikh which harboured in the present study a higher densities of commercial sponge types. Therefore, the present findings confirm those of the above mentioned authors. Again, these authors and Fouad (1929) found that the region which extends from Ras Sheikh to Abu Darash (included region B in the present study) harboured the lowest number of commercial sponges. This is in accordance with the present findings for region B. Paget (1923), Jenkins (1926), Fouad (1928 & 1929), Wimpenny (1931), McDonald (1932) and Fouzi (1933) agreed that Gulf of Kanayis (included region C in the present study) harboured more commercial sponges than the region which extends from Ras Alam el Roum to Ras Abu Laho (included region D in the present study), while Fouad (1927), Wimpenny (1930), Samra (1935) and Fouzi (1936 & 1938) found that more commercial sponges in the region which extends from Ras Alam El Roum to Ras Abu Laho than the other region. The present findings confirm those of Fouad (1927), Wimpenny (1930), Samra (1935) and Fouzi (1936 & 1938) for regions C and D but not that of the other authors.

The variations in the total of the mean numbers of the commercial sponge types along the area investigated are possibly related to gradients of the different environmental factors. Goode (1834) mentioned that the commercial sponges are confined to seas in which the differences observable between the winter and summer isotherms are not excessive. Hartman (1958) found that the time of settling of larvae of Haliclona lossanoffi fluctuates annually in relation to temperature. Larvae are released shortly after the highest water temperature of the year. Paget (1922) stated that the drop in salinity causes the death of sponges. Gattsoff (1925) found the dissociated cells of Microciona prolifera failed to coalesce in hypotonic sea water with concentrations lower than 12.4 to 9.3%o. but coalescence takes place in hypertonic solutions up to a value of 55.8%o. Laubenfels (1932) found that dissociated cells of Iotro-chota birotulata coalesced normally in solutions ranging from 80%o sea water to 110%o sea water. Above and below these values, the number of cells which aggregate per unit area is low. Hopkins (1962) reported that the distribution of boring spopnge Cliona Celata on the eastern shore of Virginia is salinity dependent and prevailing salinities below 10-15 ppt are lethal.

In the present study, the averages of the seasonal temperature and salinity at depth of catching were more or less similar in the four regions (Table 2). Accordingly, each of these two factors yielded no significant correlation with density. It is therefore, important to consider the abundance of the commercial sponge types in relation to other environmental factors.

Holme (1953) postulated that the amount of benthos is not necessarily related to the quantity of the organic matter in a deposit, but is more related to the relevance of deposit as a habitat for a particular species. In fact, no clear correlation existed between the organic and carbonate contents of the bottom sediments and commercial sponge abundance (Table 2). Therefore, the present findings confirm those of Holme (1953).

Fathy (1957) reported that commercial sponges feed on living and non living organisms of phytoplankton and zooplankton. Row et al. (1975), Pearson and Stanely (1976) assumed that the amount of benthos is proportional to the sedimented phytoplankton and zooplankton. West et al. (1976) noted that the marine invertebrates of all the major groups except arthropdos absordb dissolved free amino acids which are input from phytoplankton exudates. In the present investigation, a clear positive correlation existed between commercial sponge abundance and the concentration of phytoplankton (Table 2). Therefore, the concentration of phytoplankton can be considered as an important factor in determining the distribution and abundance of the commercial sponge types along the investigated area.

Among the many factors which affect the successful settlement of pelagic larvae of bottom invertebrates is the suitable substratum which is a master factor. Wilson (1937), Thorson (1946, 1955, 1956) mentioned that when the larvae of bottom invertebrates are ready to metamorphose to adults, they explore the substratum while drifting with water currents. If they find suitable substratum they settle on it, if not, they either perish or extend their pelagic life for a certain period of time. Hedgpeth (1954) considered that horny sponges mainly grow on coraligenonus communities. Vacelet (1959) found that the sponge species of Marseille were distributed in two biocoenoses, coraligenous and precoraligenous. Goode (1884), Moore (1910), Paget (1923), Hyman (1940), Aleem (1961), Brida (1962), and Rutzler (1975) suggested the importance of the solid substrata inculding rocks as a determinal effect on the existence of commercial sponge species. This phenomenon has also been observed in the present study in region A and D. These two regions exhibited more frequent rocky and consolidated substrata. In fact, the exact surface area of these solid substrata can not be determined to indicate significant correlation test but an approximate surface area could be obtained by the guide of Matrouh to Alexandria chart (1942) (Table 3). These two regions were richer in numbers of the three commercial sponge types. This gives an indication that this environmental factor is important in determining the abundance of the commercial sponge types along the area investigated.

Brida (1962) described the sponge bed when studying the biocoenose of the circalittoral of Adriatic as a particular biotype consisting of solid or consolidated substratum, the top of which is mush narrower than the rocky base and they are scattered on a vast area of sand. In the present study, it was observed that the shape of the rocky substratum has an influence on the aggregation of commercial sponge types. The pyramidal shape subtratum embarrasses a high number of individual sponge species. It has also been observed that regions without either rocky or consolidated substrata such as the region between Tell Fuz and Tell Alam El-Milh and between Ras El Kanayis and before Mersa Baggush are devoid of the commercial sponge types, whereas the commercial sponge beds are confined to rocky and consolidated regions.

Moore (1910) found that sponges planted on bottom covered by short grasses exhibit a more rate of growth than those planted on bare rocks. Rutzler (1975) found in his study on the ecology of Tunisian commercial sponges that rocks coverd with sea grasses Posidonia sp. and the green algae Caulespa prolifera are the most favourable habitat for massive sponge growth. In fact, the abundance of sea grasses and green algae in each region could not be determined to indicate a

TABLE .3.

Frequency of approximate surface area of solid substrata in each region with the guide of Matrouh to Alexandria chart (1942).

Region	Total of the means of the commercial spong types (individuals\Km^3.)	Rocky substrate	Consolidated substrate
El-Hammam (A)	99.45	+++	+++
El-Alamain (B)	35.63	++	+
Fukah (C)	52.42	+	+++
Matrouh (D)	64.49	+++	++

+ = rare (<5 Km^2); ++=Frequent (5-10Km^2); +++=common (>10Km^2).

significant correlation test with the total of the mean numbers of the commercial sponge types, but the frequency of sea grasses and green algae sampled throughout the different seasons (spring, summer, autumn and winter) in each region has been taken from Ramadan (1979) (Table 4). The table illustrates that region A exhibited a high production of sea grasses and green algea throughout the different seasons. This region is rich in total of the mean numbers of commercial sponge types indicating that this environmental factor is important in controlling the abundance og commercial sponge types along the area investigated.

In conclusion, it appears that the commercial sponges along the west coast of Alexandria can flourish in regions with high concentrations of phytoplankton, large surface area of rocky and consolidated substrata and high production of sea grasses and green algae.

TABLE 4

Frequency of sea grasses and green algae sampled throughout the different seasons in each region at depths of catching quated from Anon., 1979).

Region	Total of the means of the commercial spong types (individuals\Km^2.)	Season			
		Spring	Summer	Autumn	Winter
El-Hammam (A)	99.45	+++	+++	+++	+++
El-Alamain (B)	35.63	+	+	++	+
Fukah (C)	52.42	+	+	+++	+++
Matrouh (D)	64.5	++	++,	++	+

+=rare (<5 organisms); ++=Frequent(5-15 organisms); +++=common (>15 organisms).

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