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ON THE EPIFOULNG OF PFARL OYSTER *(PINCTADA RADIATA)* *IN QATARI WATER* ARABIAN GULF AND ITS INFLUENCE ON THE FLESH GROWTH

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ABSTRACT

Epifouling assemblages on pearl oyster shells in onshore and offshore' oyster beds, at Qatari water, Arabian Gulf, were investigated in relation to oyster size and flesh growth. Onshore oysters had great biofoulers and low growth parameters than offshore ones. In both beds, biofoulers were dominated by sponges, thorny oysters, polychaetes and red algae. Of these, the serpulid worm (*Serpula vermicularis*) and the thorny oyster (*Spondylus marisrubri*) were the most pronounced particularly in onshore oysters. Density of biofouler settlement increased with shell surface areas. Most biofoulers tended to settle on dorsal side of the pearl oyster except the tube worms which preferred the ventral side.

INTRODUCTION

Fouling is a major problem in bivalve farms and could have a considerable damage on the growing species (Tanita & Sato, 1953, Wada, 1973 and tive Velayudhan, 1983). The array of dominant organisms are found to vary from bed to bed and from season to season (Dharmaraj *et al.*, 1987). A considerable concern has been raised about the epifouling of cultured oysters and its influences on the animal growth and mortality (Gunter, 1955; Mohammed, 1976; Alagarswami, 1987 and Mohammed, 1994).

Little information so far exists on the biofouling of pearl oysters and its effect on pearl productions (Lunz, 1943, Reed 1966, Alagarswami & Chellam, 1976 and Dharmaraj & Chellam 1983), though few detailed studies were carried out on its impact on the growth and survival (Miyauti, 1967 and present investigation, the accumulation of fouling organisms on pearl oysters in relation to shell surface areas and animal sizes will be studied in onshore and offshore oyster beds. with particular emphasis on its influence on the oyster growth.

MATERIAL AND METHODS

Study sites:

The present investigation was conducted in two pearl oyster beds in Qatari water, Arabian Gulf. The first one is located very close to shore (onshore) (lat 25° 56 19N long 51° 34 27E) and with sandy bottom composed mainly of sand, shell fragments and rubbles. Algae (*Sargassum* spp., *Cladophora* sp.,) sea grass (*Halophila ovalis*, *Halodule* sp.) and other benthic fauna (*Clione* sp., *Acropora* spp., *Didemnum* sp., *Balanus* spp. *Serpula* spp., *Spondylus marisrubri*) were quite dense in this bed. The second bed was far away from shore (offshore) and situated north-east of Qatar (lat 25° 20 38N long 52° 14 35E). Its bottom was rocky and composed mainly of rocks, dead corals and rubbles. Benthic biota were quite less than in onshore bed and composed mainly of *Sargassum* spp., *Halophila* spp., *Acropora* spp., *Sertularia* sp., *Serpula* spp., *Hydriodes* sp., *Brachidontes* sp. and *Ophioderma* sp.).

Material sampling:

Live oysters were collected from the two beds on April 1995 and transported to the wet Laboratory, Scientific Research Centre, Qatar University. Shells height and width were measured for each animal using a Vernier caliper. Each oyster was opened to separate the flesh which then weighed as wet and after dryness at 80 °C (for 48h.) Shell valves and their biofouling organisms were preserved in 5% formalin, transported to Marine Science Laboratory, Suez Canal University and kept in dark cabinets. On December 1997, epifoulers on each side (dorsal and ventral) of oyster shells were separated, identified and their frequence of occurrences was estimated for each bed. The surface area of each oyster side was approximated by superposing the shell valves on graph paper ruled into square millimeters (Mohammed, 1976).

During sampling, temperature, salinity, pH and O_2 saturation were measured in 9 locations in each bed. Its mean values (± S.D) were 25.5 ± 1.6 °C (for temperature), 34.2 ± 0.7 ‰ (for salinity), 7.5 ± 0.1 (for pH) and 95.2 ± 5.1% (for oxygen saturation) without significant variations (one-way ANOVA, $P < 0.1$) between them.

RESULTS

Fouling biota which are settled on pearl oyster shells in the two beds were composed of 36 species representing algae, sponges, coelenterates, annelids, molluscs and ascidians (Table 1). Of these, eight groups (Fig 1) were found to be the most abundant and constitute more than 95% of the total numbers. Sponges dominated by *Haliclona* sp. were more frequent on the dorsal side of the shell, while thorny oyster (*Spondylus marisrubri*) was almost equally found on both sides. Polychaete annelides were dominated by the serpulid worm *Serpula vermicularis*, followed in order by *Hydroides elagans*, *Eunice antennata*, *Platynereis* sp. and *Spirobranchus* sp. and preferred the ventral side in both populations. Barnacle (*Balanus amphitrite*), the bivalve (*Petrie marmorta*), the red algae (*Gelidium crinala*, and *Lithothamnium* sp.) and the brown algae (*Sargassum* spp. and *Cladophora* sp.) were mostly abundant on the dorsal side. In onshore population, the frequence of occurrence of all foulers per oyster shell was significantly (Chi-square test $P < 0.01$) greater than in offshore one revealing the presence of specific environmental factors encouraging more biofoulings in onshore bed.

Dense settlements of foulers tended to occur on bigger oysters. Foulers were few (< 10%) in oysters with a shell area less than 20 cm^2 while they were abundant (> 70%.) in bigger oysters (Fig 2). This is more evident in Figure (3a), where epifoulers were scarce in juveniles (< 30 mm shell height). Although the frequences occurrence of foulers on dorsal shells were significantly greater (Chi-square test $P < 0.1$) than on ventral ones in both populations. It was, however, observed that the tubes of the polychaete *Serpula vermicularis* were heavily aggregated on the ventral surfaces of the onshore oysters and in some cases clogged the two valves together leading to oyster death each. Infestations by the polychaete *Polydora vulgaris* were rarely recorded (< 1%) in onshore population only and all infested oysters were found live but in poor condition.

The mean wet and dry flesh weights for most size groups in offshore population (Fig 3b) were significantly greater (one-way ANOVA, P <0.001) than in onshore ones. The fitted regressions between the shell heights and wet (or dry) flesh weights as follows :-

1 - For offshore oysters

ln wet weight = ln 0.108 + 1.422 ln shell height (r = 0.682 n =112, ***P***, 0.001)
ln dry weight = ln 0.0841 + 0.721 Ln shell height (r = 0.771 n = 95, ***P***, 0.001)

2 - For onshore oysters

ln wet weight = ln 0.0985 + 1.309 ln shell height
(r = 0.791, n = 131, P < 0.001)
ln dry weight = ln 0.0659 + 0.5811 ln shell height
(r = 0.851, n = 92, P < 0.001).

The slope values of these regressions reflected the superiority of growth in the offshore oysters (ANOVA test, P < 0.05 in case of wet weight & P < 0.01 in case of dry weight). Growth in shell width against shell height (shell width = 5.517 + 0.290 shell height, r = 0.915, n = 114, P < 0.001 for offshore oysters, and shell width = 5.640 + 0.274 shell height, r = 0.955, n = 127, P < 0.001, for onshore oysters) were more or less similar in the two beds.

DISCUSSION

Biofouling assemblages on pearl oyster shells were significantly greater in onshore oysters compared to offshore ones. Various investigators (Crisp. 1974, Perkins, 1974 and Dharmaraj *et al.*, 1987) have pointed out the importance of water currents on the biofouling settlement and found that current speeds above 2 knots were sufficient to prevent their settlements. In offshore water, gyral circulation with current speeds above 1 knot are existing, (Parker *et al.* 1993) while in onshore water, the tidal currents with velocities ranging from 0.1 to 0.3 knots were the general pattern (Hunter 1986; Hassan & Hassan, 1987). The low current speeds in onshore bed encouraged more settlements of biofoulers on oyster shells compared to offshore ones.

The constituents of foulers vary from place to place and from season to season. In Ago Bay, Japan, the dominated fouling organisms are the tubiculous polychaetes, bryozoans, barnacles, ascidians, edible oysters and other bivalves (Yamamura *et al.* 1969), whereas in Veppalodai, India, barnacles and bryozons were the most dominant (Dharmaraj *et al.* 1987). In Kuwaiti water, Mohammed (1976) found that, polychaetes and particularly *Serpala vermicularis* constituted 80% of the epifoulers on pearl oysters. Biofouling assemblages in the present study are dominated by sponges thorny oysters, polychaetes and red algae. Of these, the serpulid worm (*Serpula vermicularis*) and the thorny oyster (*Spondylus marisrubri*) were the most pronounced particularly in onshore population.

Infestation by the Polychaete *Polydora* spp. is quite common in pearl farms and caused considerable damage to the oyster shells (Mizumoto, 1964, Dharmaraj & Chellam 1983 and Dharmaraj *et* al., 1987). Mohammed (1976) recorded a few infestation (< 3%) by *Polydora vulgaris* in the cultured oysters without influences on oyster growth and survival. Infested oysters were negligible in offshore population and rare in onshore one, suggesting a relatively clean water of Qatari coast from such infestation.

The amount and frequence of epifoulers increased with oyster sizes revealing higher possibilities of their settlement with larger shell surface areas. This result agrees mostly with that recorded in fouling experiments (Crisp. 1974 and Ghobashy & EL-Komy 1982) in that density of settlements increase with substrate surface areas and with the duration of exposure.
In the present work it was reported that most epifoulers in both populations, tended to settle on dorsal sides of oyster shells except the tube worms which preferred the ventral ones. Similarly in Kuwaiti water, Mohammed (1976) found that large barnacles, gastropods and corals settle on dorsal valves of the shells while the serpulid worms settle on ventral ones. Dharmaraj *et al* (1987), however, recorded no significant differences between the fouling communities on the two sides of the shell. Therefore, the preference of fouling organisms to settle on either side needs to be investigated with respect to the environmental conditions and substrate nature.
The mean values of wet weights and dry weights for different size groups as well as the slope values of growth regressions reflect the reduction in growth rates of the onshore oysters which suffered from higher foulings. It is suggested that the more fouling, the more energy required for animals to open its valves for food filtration and respiration (Alagaraswami, 1987 and

Mohammed, 1994) and consequently the reduction in growth among the fouled oysters (Miyauti, 1967,' Mohammed 1976). The extent of damage caused to oysters was correlated particularly with the size and volume of fouling loads. In pearl farms, Nishi (1961), Wada (1973) and Dharmaraj *et al* (1987) reported an inverse relationship between the volume of the foulers and the animal growth. They strongly recommended the continuous cleaning of cultured oysters from biofoulers they cause catastrophic damage to the oyster populations and to the produced pearls.

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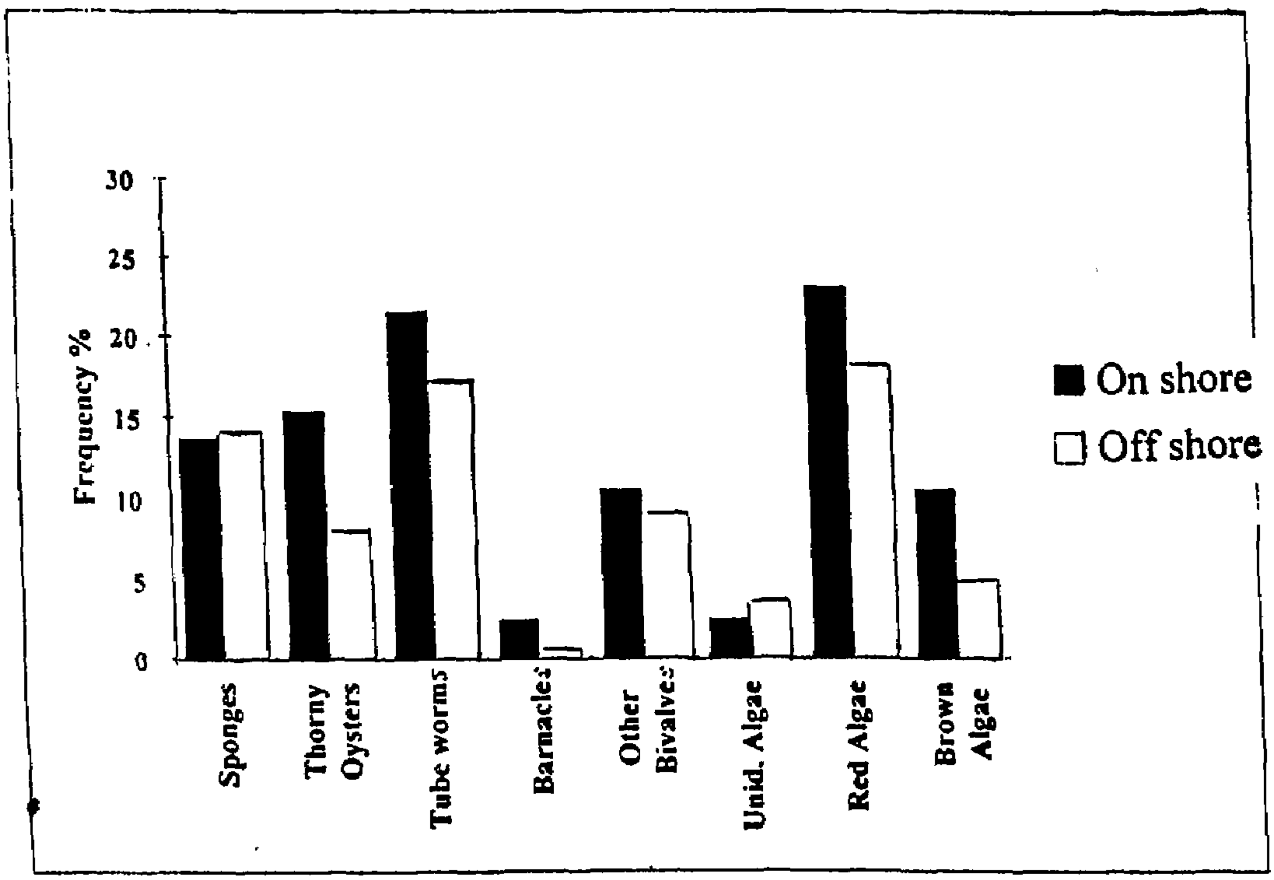
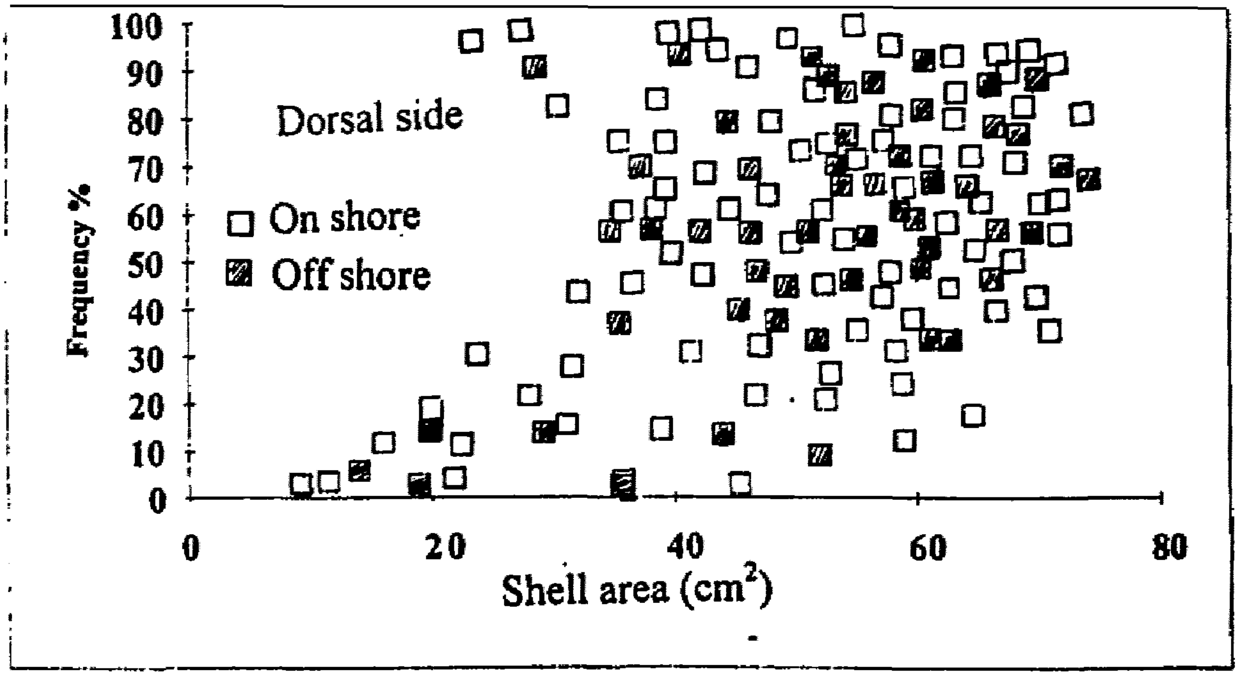


Fig. 1 Frequence occurrence of the dominant pearl oyster epifoulers in the investigated beds



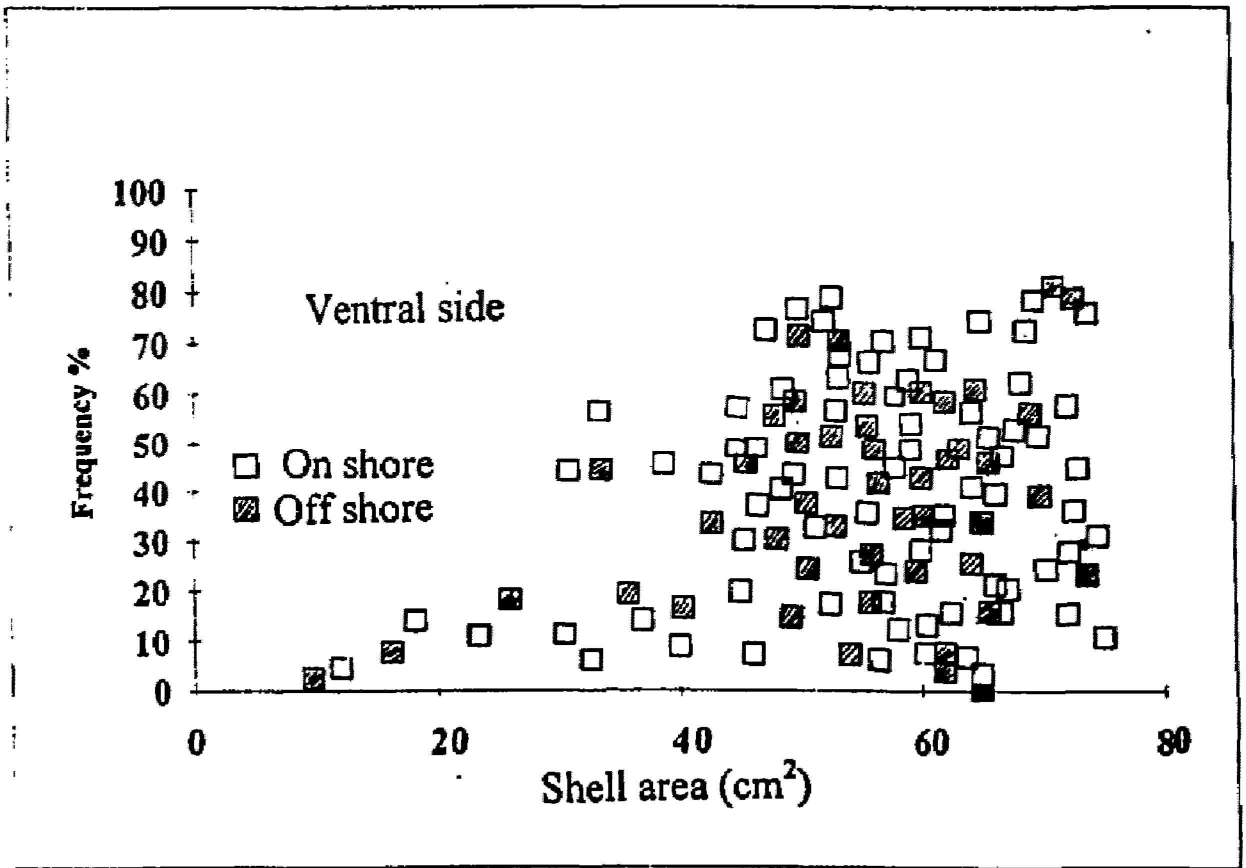


Fig 2 Variations in the frequence occurrence of the epifoulers with shell areas

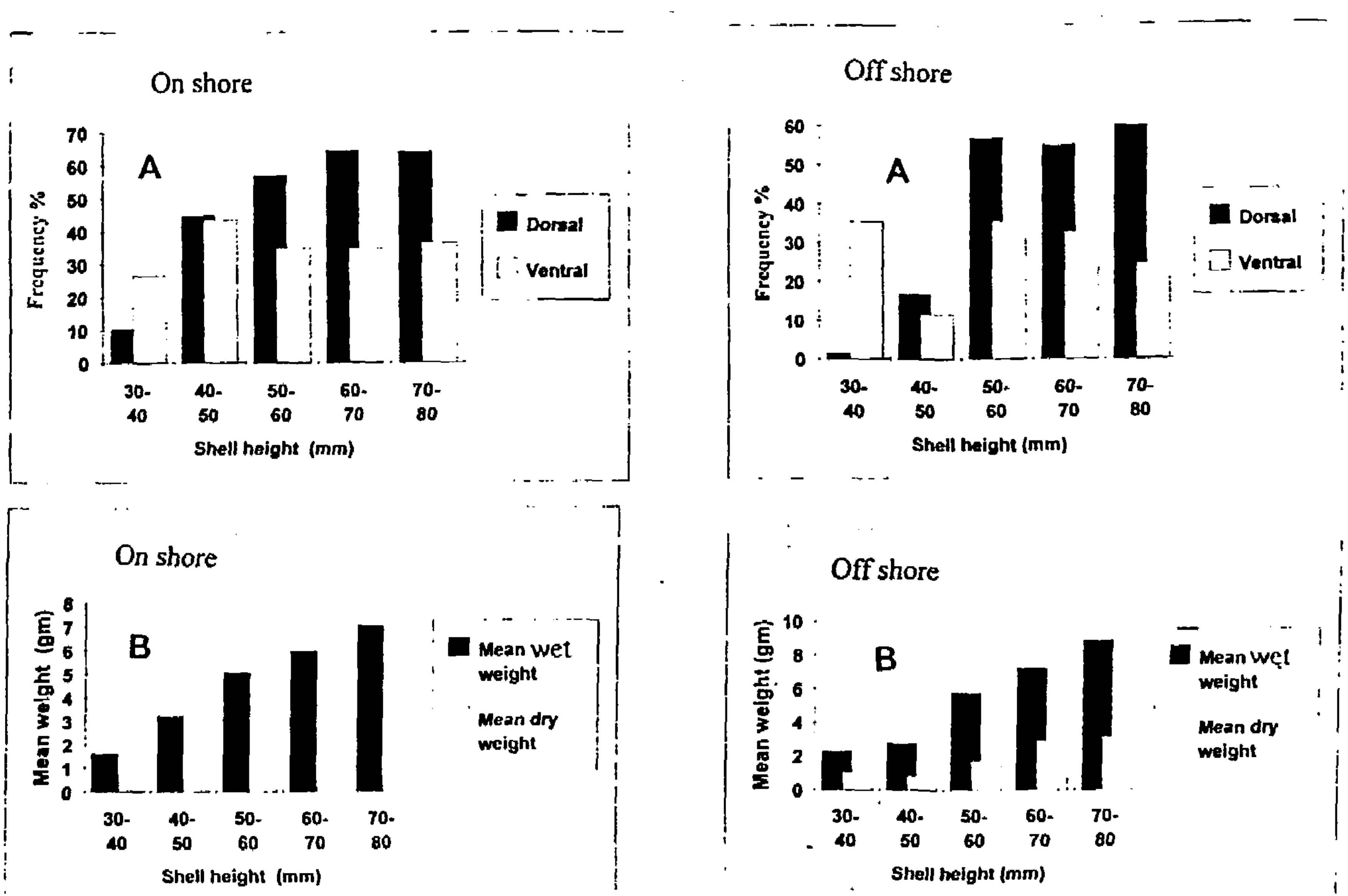


Fig 3 Variations in the frequence occurrence (%) of the epifoulers (A) and mean flesh weights (B) with shell heights

Table 1: Checklist of the epifoulers of pearl oysters in Qatari water, Arabian Gulf

1 - Red algae (Rhodophyta)	**6 - Annelida**
Lithothamniun sp.	*Syllis* sp.
Gelidium crinala	*Serpula vermicularis*
Gracilaria foliifera	*Glycera* sp.
Hypnea sp.	*Eunice* sp.
Dasya ocellata	*Perinereis cultrifera*
2 - Brown algae (Phaeophyta)	*Polydora vulgaris*
Sargassum baveanum	*Hydroides elegans*
Sargassum angustifolum	**7 - Crustacea**
Padina gymnospora	*Balanus amphitrite*
Hydroclathrus sp.	*Sphaeroma* sp.
Cladophora sp.	**8 - Mollusca**
3 - Green algae (Chlorophyta)	*Spondylus marisrubri*
Unidentified 2 species	*Spondylus* sp.
4 - Porifera	*Chlamys* sp.
Clione sp.	*Ostrea cucullata*
Haliclona sp.	*Modiolus* sp.
5 - Coelentrata	*Pinctada radiata*
Obelia geniculata	*Pinctada margaritifera*
Hydra sp.	*Pterie marmorata*
Sertularia sp.	**9 - Ascidiacea**
Favia sp.	*Didemnum candidum*

تجمعات الحشف المصاحب لمحار اللؤلؤ
فى مياه قطر بالخليج العربى على نمو الكتله الحيه

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تم فى هذا البحث دراسة تجمعات الحشف المتواجده على أصداف محار اللؤلؤ وعلاقاتها بحجم المحار ونمو الكتله الحيه فى موقعين لمحار اللؤلؤ فى المياه القطريه بالخليج العربي أحدهما قريب من الشاطئ والأخر بعيد عنه. ولقد تميز المحار في الموقع القريب من الشاطئ بكثره الحشف على الأصداف وقلة نمو الكتله الحيه (الوزن الرطب والوزن الجاف) مقارنة بالمحار المتواجد فى الموقع البعيد عن الشاطئ .. وفى كلا الموقعين سادت الأسفنجيات والديدان عديدة الاشواك والمحاريات الشوكيه والطحالب الحمراء على أنواع الحشف الأخرى. وكانت الديدان الأنبوبية من نوع سربيولافيرميوكيولاريس والمحاريات الشوكيه من نوع سبونديلاس موريسروبرى هى الأكثر شيوعاً فى الحشف خاصة فى الموقع القريب من الشاطئ.

وقد لوحظ تزايد كثافة استقرار الحشف على أصداف المحار ذات الأحجام الكبيره وذلك يرجع الى زيادة مدة التعرض ومساحة السطح لها مقارنة بالأحجام الصغيره ، كما لوحظ أن معظم الحشف إستقر على الناحيه الظهريه للأصداف عدا الديدان الأنبوبية والتى فضلت الناحيه البطنيه.