# Effect of lessepsian immigrant species on demersal catches operating along the Egyptian Mediterranean waters

**Shnoudy A. Bakhoum; Amal E. Philips and Evelyn Ragheb**
National Institute of Oceanography and Fisheries, Alexandria, Egypt.

## ABSTRACT

The present study was carried out on the lessepsian immigrant fishes caught with trawl nets in the Egyptian Mediterranean waters. Based on previously reported data during summer and winter 2008 and winter & spring 2009, along the western and eastern Egyptian Mediterranean waters from El-Arish to El-Salloom using the research vessel "Salsabil" of the National Institute of Oceanography and Fisheries.

The relative abundance by number and weight of immigrant species represented 60.46% and 48.50% respectively from the total fish catch. El –Shalya region contained the most abundant species by number (94.41%) and weight (95.11%).

The analysis of variance test, indicated that differences in abundance of immigrant species in different water depths by number ($F = 1.225$, $p > 0.05$) and by weight ($F = 1.235$, $p > 0.05$) were not significant. The most common immigrant species was *Erugosquilla massavensis*, representing 26.61% by number, and *Fistularia commersonii* dominated the immigrant species catches by weight (23.22%).

Immigrant fishes expanded their distribution up to El-Salloom at the western border of the Egyptian Mediterranean coast. The results of Shannon's Index (H') and Simpson's dominance index (c) led us to consider that the local community at depth 100-150 was more diverse than other habitats.

**Keywords:** The lessepsian immigrant species, trawl net catch, Egyptian Mediterranean waters.

## INTRODUCTION

The south – eastern Egyptian Mediterranean coast has been subjected to effects of important events, such as the opening of the Suez Canal in 1869 and the construction of the Aswan High Dam in 1964 and the discharge of high rates of drainage water. The opening of the Suez Canal in 1869 connected the Red Sea to the Mediterranean and allowed the introduction of numerous Indo- Pacific species into the Mediterranean (Golani, 1998). The process of immigration through the Suez Canal increased from 12 species in 1882 to 92 alien species of Indo-Pacific origin in 2010 (Keller, 1882 and Zenetos *et al.*, 2010).

The catch from the Egyptian waters accounted for about 5.92% of the total Mediterranean production in 1990. Its proportion was raised to 8.27% in 2006, but no clear trend could be reliably inferred regarding the quality of the data provided by some of the member countries (Eurostat, 2008).

The catch from the Egyptian Mediterranean waters reached to 88882 tons in 2008, then was decreased to 77799 tons in 2011 (GAFRD, 2011).

Many of the lessepsian immigrant species are now apparently well established in the eastern Mediterranean and became an economically important item in the fisheries of the Egyptian Coast, such as Brush-tooth lizard fish, *Saurida undosquamis*, (Shenouda, 1986) and narrow–barred Spanish mackerel *Scomberomorus commerson* (Bakhoum, 2007).

The purpose of this study was to reveal the successful propagation and economical importance of lessepsian immigrant species in the fisheries of Egyptian Mediterranean waters.

## MATERIALS AND METHODS

An experimental trawling fishing survey was carried out during summer and winter 2008 and winter & spring 2009, along the western and eastern Egyptian Mediterranean waters from El-Salloom to El-Arish, by using the research vessel "Salsabil" of the National Institute of Oceanography and Fisheries.

The fishing hauls were carried out at different depths (<50, 50-100 and >100m).

The catches of trawling operations were identified to species. For each fish, total length (mm) and total weight (g) were recorded.

Two types of Trawl nets of Japanese design were used in the El-Salsabil vessel, these were as follows.

1- The first one was with one cod-end type, its length was 36m long, while the head rope reached about 28m. The stretched mesh size of such net was 160mm at its wing. It ranged from 120mm at the front belly to 60cm for net belly, while the mesh size of the cod end was 30mm.

2- The second one was of two cod-ends, its head rope was 43.6m and the footrope was 50m. The stretched mesh size of such net ranged gradually from 120mm at its wing to 90mm at the belly and 40mm at the cod end. Two strengthening galvanized side lines (18mm thickness) were attached to the outer and inner sides of the belly and cod end. The outer rope measured 19.4m and the inner rope measured 16.60m.

Biodiversity was calculated based on the formulae developed by Shannon-Weaver (1949), Shannon's Index (H') and Simpson's dominance index, (c), (Simpson, 1949).

## RESULTS

The relative abundance by number and weight of immigrant species in the Egyptian Mediterranean bottom catch revealed that, they represented 60.46% and 48.50% respectively (Table 1).

The variations in Abundance of immigrant species in different localities of the Egyptian Mediterranean water showed that, El –Shalya region contained the most abundant species by number (94.41%) and weight (95.11%) followed by Alam El-Rom by number (88.78%) and El-Arish by weight (92.99%)(Table 1).

Rate of expansion of immigrant species in the Egyptian Mediterranean waters showed that they expanded their distribution up to El-Salloom in the western border of the Egyptian Mediterranean coast (Fig. 1).

Table 1: Abundance of immigrant species captured by trawl net in different localities of the Egyptian Mediterranean waters.

| Regions | Total catch | | Immigrant species catch | | Abundance | |
|---|---|---|---|---|---|---|
| | Number | Weight (Kg) | Number | Weight (Kg) | N % | W % |
| El-Arish | 1534 | 72.47 | 1294 | 67.39 | 84.35 | 92.99 |
| Sahl El-Tina | 319 | 25.25 | 148 | 14.99 | 46.39 | 59.37 |
| Damietta | 593 | 143.12 | 413 | 77.06 | 69.65 | 53.84 |
| El-Manzalah | 338 | 21.16 | 162 | 8.19 | 47.93 | 38.71 |
| Baltim | 757 | 49.91 | 576 | 21.87 | 76.09 | 43.82 |
| Gamasa | 690 | 52.14 | 512 | 20.26 | 74.2 | 38.86 |
| El Brulous | 212 | 15.37 | 74 | 4.46 | 34.91 | 29.02 |
| Rosaetta | 1181 | 112.79 | 669 | 77.06 | 56.65 | 68.32 |
| Abu-Qir | 838 | 170.78 | 349 | 43.40 | 41.65 | 25.41 |
| San Stefano | 221 | 8.96 | 183 | 7.73 | 82.81 | 86.27 |
| Eastern harbor | 413 | 29.86 | 207 | 11.01 | 50.12 | 36.87 |
| EL-Hamam | 131 | 8.49 | 33 | 2.32 | 25.19 | 27.33 |
| El-Alamain | 344 | 30.38 | 254 | 13.69 | 73.84 | 45.06 |
| El-Dabah | 170 | 21.81 | 56 | 13.42 | 32.94 | 61.53 |
| Foka | 382 | 15.32 | 286 | 13.06 | 74.87 | 85.25 |
| Ras EL-Hekma | 56 | 24.15 | 26 | 4.85 | 46.43 | 20.08 |
| El -Shalya | 143 | 12.06 | 135 | 11.47 | 94.41 | 95.11 |
| Alam El-Rom | 98 | 11.76 | 87 | 9.62 | 88.78 | 81.80 |
| Marsa Matroh | 49 | 2.42 | 37 | 1.49 | 75.51 | 61.57 |
| Sedi brani | 347 | 26.48 | 106 | 6.38 | 30.55 | 24.09 |
| El-Salloom | 878 | 48.44 | 254 | 8.30 | 28.93 | 17.13 |
| Total | 9694 | 903.12 | 5861 | 438.02 | 60.46 | 48.50 |
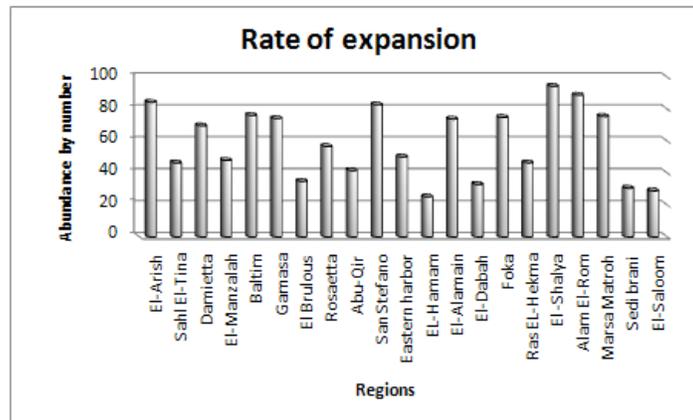


Fig. 1: Rate of expansion of immigrant species captured by trawl net in the Egyptian Mediterranean waters.

*Erugosquilla massavensis* dominated the immigrant species catches by number (26.61%) and *Fistularia commersonii* by weight (23.22%), while the second rank was represented by *Leiognathus klunzingeri* (13.24%) by number and *Lagocephalus spadiceus* (19.69%) by weight (Table 2).

Catch percentage by number and weight of economic & non- economic immigrant species captured by trawl net in the Egyptian Mediterranean waters revealed that fishes dominated the immigrant species by weight (82.56%) and number (63.56%) (Fig. 2a). Catch percentage by number and weight of economic & non-economic immigrant fishes showed that non-economic species were more abundant by weight and number (75.41% & 59.33% respectively) (Fig. 2b), Meanwhile, the non-economic immigrant species showed that the non-economic fishes were more abundant by weight (78.12%) and number (50.85%) to the non- economic species

captured by trawl net, while, the crustacean species were 21.88% & 49.15% by weight and number respectively to the non- economic species captured by trawl net. (Fig. 2c).

Table 2:  Abundance by number and weight of immigrant species captured by trawl net in the Egyptian Mediterranean waters.

| Species | Abundance | | | |
|---|---|---|---|---|
| | Number | N % | Weight (gm) | W % |
| **The most economic species:** | | | | |
| I. Fishes: | | | | |
| *Stephanolepis diaspros* | **100** | **12.61** | **3153** | **6.61** |
| *Saurida undosquamis* | **39** | **4.92** | **3059** | **6.41** |
| *Scomberomorus commerson* | **36** | **4.54** | **2890** | **6.06** |
| *Siganus rivulatus* | **24** | **3.03** | **516** | **1.08** |
| *Alepes djedaba* | **5** | **0.63** | **66** | **0.14** |
| *Siganus luridus* | **1** | **0.13** | **3** | **0.01** |
| Total | 205 | | 9687 | |
| The non-economic species: | | | | |
| **I. Fishes:** | | | | |
| **Leiognathus klunzingeri** | **105** | **13.24** | **465** | **0.97** |
| *Fistularia commersonii* | **72** | **9.08** | **11078** | **23.22** |
| *Terapon puta* | **59** | **7.44** | **2933** | **6.15** |
| *Himantura uarnak* | **15** | **1.89** | **4228** | **8.86** |
| *Lagocephalus spadiceus* | **14** | **1.77** | **9396** | **19.69** |
| *Lagocephalus scleratus* | **8** | **1.01** | **748** | **1.57** |
| *Etrumeus teres* | **8** | **1.01** | **223** | **0.47** |
| *Upeneus moluccensis* | **8** | **1.01** | **185** | **0.39** |
| *Nemipterus japonicus* | **5** | **0.63** | **431** | **0.90** |
| *Pteragogus pelycus* | **4** | **0.50** | **8** | **0.02** |
| *Upeneus pori* | **1** | **0.13** | **15** | **0.03** |
| Total | 299 | | 29710 | |
| **II. Crustacea** | | | | |
| *Erugosquilla massavensis* | **211** | **26.61** | **3511** | **7.36** |
| *Metapenaeus monoceros* | **64** | **8.07** | **345** | **0.72** |
| *Portunus pelagicus* | **14** | **1.77** | **4465** | **9.36** |
| Total | 289 | | 8321 | |
| **Total** | **793** | | **47718** | |
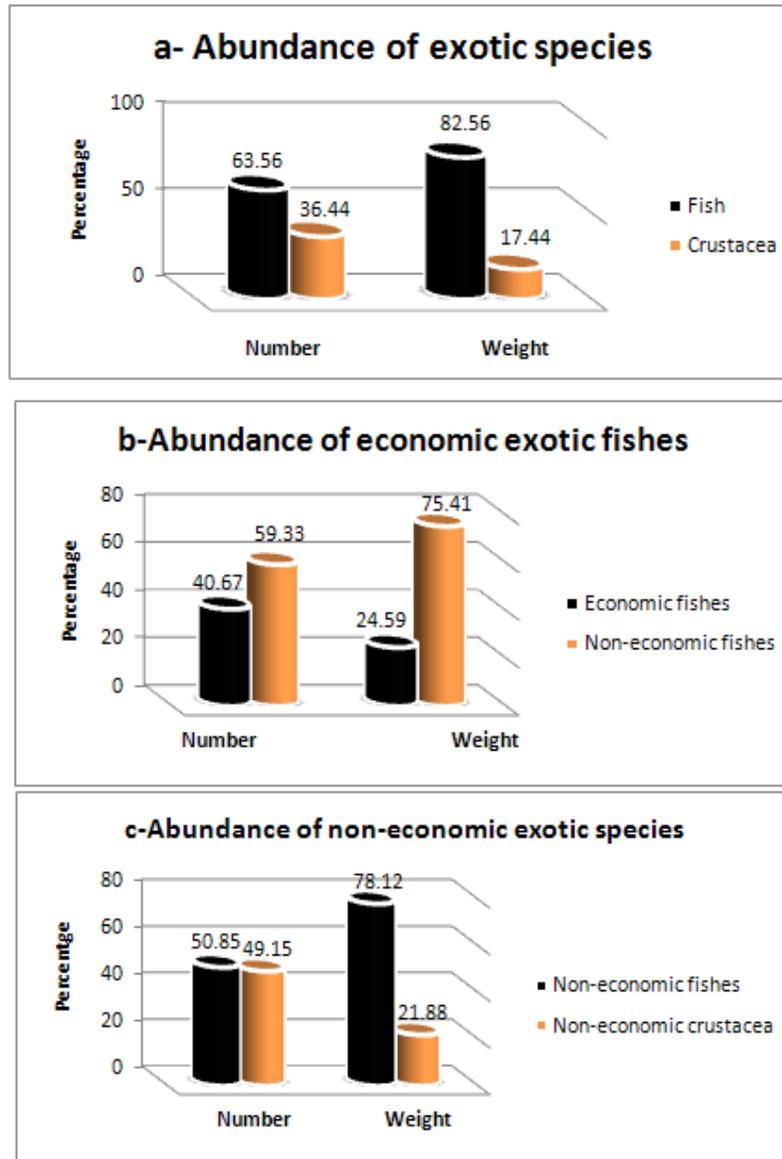
Fig. 2: Catch percentage by number and weight of immigrant species for: a- Exotic species, b-Economic exotic fish, c- Non-economic exotic species, captured by trawl net in the Egyptian Mediterranean waters.

The most common economic fish species was *Stephanolepis diaspros* representing 32.55% by weight and 48.78% by number followed by *Saurida undosquamis* (31.58% by weight & 19.02% by number) of the most economic fish species. The most common non-economic fish species by weight was *Fistularia commersonii* (37.29%) of the non-economic fish species, while *Leiognathus klunzingeri* was dominated by number (35.12%) of the non-economic fish species. The most common non-economic crustacean species was *Portunus pelagicus* representing 53.66% by weight of the non-economic crustacean species, while *Erugosquilla massavensis* dominated by number (73.01%) of the non-economic crustacean species.

The comparison between abundance of immigrant species at different water depths using the analysis of variance test, indicated that differences in abundance by

number (F = 1.225, p > 0.05) and by weight (F = 1.235, p > 0.05) were not significant (Table 3, Fig. 3).

Table 3:  Abundance of immigrant species captured by trawl net in different depth of the Egyptian Mediterranean waters.

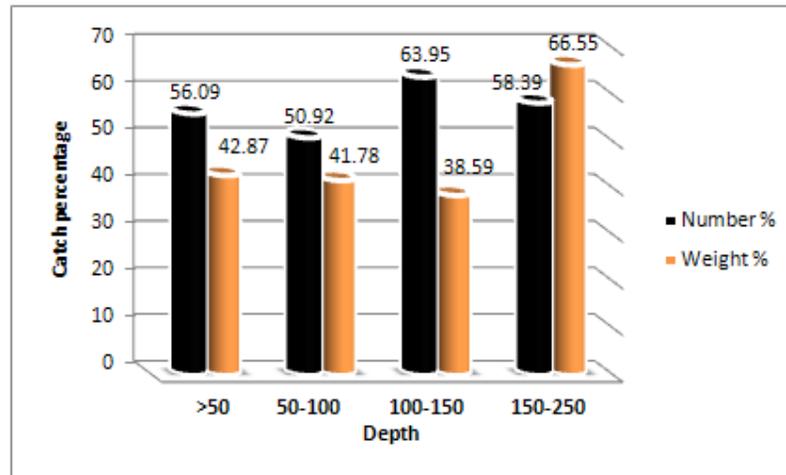| Depth | Total catch | | Immigrant species catch | | Abundance | |
|---|---|---|---|---|---|---|
| | Number | Weight (Kg) | Number | Weight (Kg) | N% | W% |
| >50 | 4411 | 405.54 | 2474 | 173.86 | 56.09 | 42.87 |
| 50-100 | 2977 | 226.87 | 1516 | 94.78 | 50.92 | 41.78 |
| 100-150 | 430 | 30.01 | 275 | 11.58 | 63.95 | 38.59 |
| 150-250 | 757 | 38.69 | 442 | 25.75 | 58.39 | 66.55 |



Fig. 3: Catch percentage by number and weight of immigrant species captured by trawl net in different depth of the Egyptian Mediterranean waters.

The immigrant species revealed inhabitation variations at different depths of the Egyptian Mediterranean waters. Most of them were found at depth from 50 to 100m (13 species) while at water depth less than 50m (10 species). Three immigrant species were found at depth from 150 to 250 meter, while two species inhabited depth from 100 to 150 meter. Only *Nemipterus japonicus* were found at different water depths (Table 4).

The results of Shannon's Index (H') and Simpson's dominance index (c) led us to consider the local community at depth 100-150 was more diverse than others followed by depth 150 to 250, while 50-100 and <50 depth, communities represented the third and fourth rank respectively (Table 5).

Table 4:  The immigrant species captured by trawl net in different depth of the Egyptian Mediterranean waters.

| Species | Depth | | | |
|---|---|---|---|---|
| | >50 | 50-100 | 100-150 | 150-250 |
| Economic species: | | | | |
| *Stephanolepis diaspros* | + | | | |
| *Saurida undosquamis* | | + | | + |
| *Scomberomorus commerson* | + | + | | |
| *Siganus rivulatus* | + | + | | |
| *Alepes djedaba* | + | | | |
| *Siganus luridus* | | + | | |
| Non-economic species: | | | | |
| I. Fishes: | | | | |
| *Leiognathus klunzingeri* | + | | | |
| *Fistularia commersonii* | | + | | |
| *Terapon puta* | + | | | + |
| *Himantura uarnak* | | + | | |
| *Lagocephalus spadiceus* | | + | | |
| *Lagocephalus scleratus* | | + | | |
| *Etrumeus teres* | + | | | |
| *Upeneus moluccensis* | + | | | |
| *Nemipterus japonicus* | + | + | + | + |
| *Pteragogus pelycus* | | + | | |
| *Upeneus pori* | | + | | |
| II. Crustacea: | | | | |
| *Erugosquilla massavensis* | | + | | |
| *Metapenaeus monoceros* | + | | + | |
| *Portunus pelagicus* | | + | | |

Table 5:  The diversity of immigrant species captured by trawl net in different depth of the Egyptian Mediterranean waters.

| Depth | Shannon's Index (H') | Index of Dominance (C) |
|---|---|---|
| Depth >50 | 0.35± 0.01 | 0.13± 0.33 |
| Depth 50-100 | 0.52± 0.15 | 0.19± 0.20 |
| Depth 100-150 | 0.66± 0.04 | 0.50± 0.42 |
| Depth 150-250 | 0.65± 0.28 | 0.37± 0.36 |

## DISCUSSIONS

The increased awareness of the impact of alien species on native biodiversity led to intensified research efforts on immigrant fish's communities and their role on the Mediterranean fisheries.

Endemic species represent only 28-29% of the Mediterranean fauna. Atlantic origin species were dominating (50.2%), while Atlantic-Pacific origin and Indo-Pacific origin species were represented by 16.8% and 4.4% respectively (Emig and Geistdoerfer, 2004).

The catch from the Egyptian Mediterranean waters was increased as percent of the total Mediterranean production (Eurostat, 2008) It is not only attributed to increase fish efforts but also to increased rate of immigrant fishes in total catch. Recently, many of immigrant species are playing important role in raising fish production. Halim and Rizkalla (2011) gave a check-list of 42 immigrant Erythrean fish in Egyptian Mediterranean where 17 of them are commercially exploited.

The ecologists consider the spread of "invasive" species as a major threat to biodiversity in the marine environment (Dukes, 2003). The spread of non-native

species into the Mediterranean depends on its ability to adapt in host environment and food competition with relative species. The water salinity plays an important role in the distribution of invasive aliens, whereas *Fistularia commersonii* inhabit high salinity water west of Egyptian Mediterranean coast. Some non- native species were proved to be highly euryhaline, which is being able to penetrate to a wide salinity range such as *Terapon puta,* which was spread from east to west of Egyptian Mediterranean waters. In addition, water temperature determined the distribution of immigrant species in Mediterranean waters, whereas only 16 of these exotic species have extended their distribution as far as the Aegean Sea (Golani *et al.*, 2002). These exotic species including *Scomberomorus commerson, Alpes djedaba, Stephanolepis diaspros, Fistularia commersonii, Siganus rivulatus, Siganus luridus* and *Saurida undosquamis* showed that the environmental conditions in the East and the North of the Mediterranean Sea satisfy their its requirements for successful adaptation in the new habitat. *Saurida undosquamis* has increased in the Mediterranean Sea in subsequent years, to the point that it is now considered as an important economic species on the Asian Coast (Ben-Yami and Glaser, 1974) and the Egyptian Coast (Wadie and Shnenouda, 1985; Shnenouda, 1986). Bakhoum (2007) found that the diet and feeding habits of immigrant predator *Scomberomorus commerson* to the Levant Basin of the Mediterranean Sea are similar to *Trichiurus lepturus*. Competition for fish prey is not a major determinant of propagation of *Scomberomorus commerson* due to the increasing numbers of the dominant food prey "anchovy" in the Egyptian Mediterranean waters.

The invasive species not only have adverse impact on biodiversity but also on human health ,the puffer fish, *Lagocephalus* spp., which proved to be a serious hazard to consumers, causing lethal cases due to tetrodotoxin, a poisonous substance (Halim and Rizkalla, 2011). On the other hand, it should not be forgotten that several examples can be given, demonstrating that many exotic species has been of economic benefit. The statistics of GAFRD, (2011) showed that *Scomberomorus commerson, Siganus* spp. and *Saurida undosquamis* are playing important role in raising Egyptian fish production from Mediterranean waters.

## ACKNOWLEDGEMENTS

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## ARABIC SUMMARY

### تأثير الأنواع الأسماك المهاجرة نحو الشمال عبر قناة السويس على الصيد القاعى بطول مياه البحر المتوسط المصرية

**شنودى أنور باخوم ـ آمال إسكندر فيلبس ـ ايفيلين راغب**
المعهد القومى لعلوم البحار و المصايد بالاسكندرية ، مصر

أوضحت هذه الدراسة حالة الأسماك المهاجرة الى شمال قناة السويس المصادة بشباك الجر فى مياه البحر المتوسط المصرية. وأعتمدت الدراسة على تقارير أعدت خلال صيف-شتاء ٢٠٠٨ و شتاء-ربيع ٢٠٠٩ بطول الساحل الجنوبى الغربى للبحر المتوسط فى المياه المصرية من السلوم إلى العريش باستخدام سفينة الأبحاث "سالسبيل" الخاصة بالمعهد القومى لعلوم البحار والمصايد.

أظهرت نتائج الدراسة أن الوفرة النسبية ( Relative abundance ) بالنسبة لعدد وكم هذه الأنواع المهاجرة مثل بـ ٦٠٬٤٦ % و ٤٨٬٥٠ % على التوالى وأن منطقة الشاليه كانت هى المنطقة الأكثر تراكم للأنواع عدديا (٩٤٬٤١ %) وكميا (٩٥٬١١ %).

كما أشارت المقارنات الإحصائية ( Variance analysis test ) إن الإختلاف فى الوفرة للأنواع المهاجرة فى الأعماق المختلفة مع العدد والكم كان غير جوهري. وان أكثر الأنواع إنتشارا عدديا هو اريجوسكولا ماسافينسيس بنسبة (٢٦٬٢١ %) وفيستيولاريا كوميرسون كميا بنسبة (٢٣٬٢٢ %).

كما امتد انتشار هذه الأنواع المهاجرة غربا حتى السلوم ـ بحدود ساحل البحر المتوسط فى المياه المصرية. كما أودت بنا نتائج معامل شانون ('H) ومعامل سيمبثون (c) ان التجمعات عند العمق ١٠٠ ــ ١٥٠م كانت الأكثر اختلافا.