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RESEARCH PAPER

Fish Assemblages in Surf Zone of the Egyptian Mediterranean Coast off Alexandria

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Abstract

Assess the state of fish assemblies in surf zone of the Egyptian Mediterranean coast off Alexandria was carried out by determining community parameters such as abundance, diversity and impact of Immigrant fishes on species composition. Fish community in Beach area off Alexandria includes 22 families. Only 9 species dominated the catch representing 81.41% by number and 60.89% by weight. Immigrant fishes in beach area included 10 of 45 species, these migrant species representing about half of the community by number (47.07 %) and 38.34% by weight. The index of relative dominance (% IRD) revealed that *Siganus rivulatus* was dominated in Beach area contributing about 54.47% and it represent frist rank by number in all seasons. The results of biological indices lead us to consider fish community in summer more diverse than in others seasons. Relation between fullness index and numerical abundance of dominant fish species showed that, the Maximum values of both indices were found for *S. rivulatus* and *Scomber japonicas* in spring and for *Stephanolepis hispidus* in winter, while *Pagellus erythrinus* reavealed the maximum fullness index in autumn and and highst numerical abundance in winter. Significant positive correlation was found between abundances of *Diplodus vulgaris* and *Pagellus erythrinus* (r=0.98**), and between *Sardinella aurita* and Boops *boops* (r=0.99**), in contrary, *Sardinella aurita* revealed significant negative correlation with *Stephanolepis hispidus* (r=-0.89*). Ecological impacts of invasive alien species are decline in abundance of endemic species. The dominance of alien species can attributed to their ability to tolerate multiple anthropogenic stressors, in altering communities.

Introduction

Many interacting physical and biological factors influence the occurrence, distribution, abundance and diversity of fish species in different fish communities.

The opening of Suez Canal, building High Dam on the Nile River. In additon to, human activities including industrial, domestic sewage outflow and industrial installations along the Mediterranean coast of Alexandria, has been affecting immensely the local biota.The first main factor affecting the abundance of the most common species in Egyptian Mediterranean coast is the opening Suez Canal, which becomes connect between Red Sea and Mediterranean Sea, it has led to great changes in the distribution of native and non–native fishes (Golani, Orsi-relini, Massuti, & Quignard, 2002).

The process of immigration through the Canal increased from 12 species in 1882 to 92 alien species of Indo-Pacific origin in 2010 (Keller, 1882 andZenetos,

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Gofas,Verlaque, Cinar, & Bianchi, 2010).

The River Nile before the construction of Aswan High Dam, used to contribute of $34x10^9$ m^3 of fresh water to the Mediterranean Sea during the flood period between August and November every year (Morsi, 1994). This has led to observed peaks in the concentrations of the nutrients and in the plankton standing crop in the Mediterranean areas affected by the Nile discharge (Halim, Guerguen, & Saleh, 1967). According to Fahmy, Abbas, and Beltagy (1996) after 30 years of the High Dam erection the present level of the nutrients in Egyptian Mediterranean waters was decline with time, due to the continuous decrease of the Nile water discharge to this coastal area in front of Egypt. This decrease in fertility of the southeastern Mediterranean waters had a catastrophic effect on marine fisheries, specially, planktonic feeder such as *Sardinella aurita*. Whereas, the sardine catch were decreased from a total of 18,000 tons in 1962 to 460 tons were landed in 1968 (Dowidar, 1984).

The third factor affecting on fish community is Alexandria's coastal ecosystem has undergone severe degradation over the past few decadesfrom discharge of untreated or partially treated sanitary and industrial wastes (Hussein, 2000 and Shreadah, Said, Younis, & Farag, 2006). For example, El-Mex Bay received a huge amount (about $6.75×10^6$ m^3 d^{-1}) of agricultural, industrial and domestic waste water discharged into the bay from El-Umum Drain without any effective treatment (Mahmoud, Masoud, Shaltout, & Hussien, 2009). Consequently, it exhibits some characteristics typical of an advanced trophic state; namely, the permanently intense phytoplankton growth (Ismael, Hemeda, Jammo, & El-Rayes, 2005; Ismael & Halim, 2007).

The Beach area is important surf zone for fish management. Many fishes inhabit surf zone for spawning and nursery grounds (Lasiak, 1986; Senta & Kinoshita, 1985; Esposito, Castriota, Battaglia, Consoli, Romeo, Scotti, Andaloro, 2015). In addition to, it play role in protection fishes against predators and increased feeding opportunities (Layman, 2000; Selleslagh & Amara, 2007). This area is characterized by sandy bottom with chains of natural rocks; these rocks provide excellent substrata for a rich algal flora and are subjected to wave's action (Ismael, 2012).

In the present study, I attempt to describe the species composition, abundance, biomass and internal structure of the surf-zone fish assemblages, to determine the role of ecological structure on fish community's parameters in the beach waters of Alexandria.

Materials and Methods

Study Area and Sampling

The examined Beach area lies between longitudes 29◦ 50' E - 30◦ 00' E and latitudes 31◦ 05' N - 31◦ 20' N of the Eastern Mediterranean coast of Egypt, it extends for about 25 km^2 from Al-Max to El-Mandara West of Alexandria. Seasonally samples were taken from December 2011 to May 2014 at five beaches: Al-Max, Shatby, Gleem, Sidi Bichr, and El-Mandara (Figure 1).

The commercial catch from Beach area almost was exclusively by trammel net, trammel net used in present study has mesh size of outer layer 15 cm, while mesh size of inner layer was 5.2 cm.

Samples were taken from the catch to laboratory for species identification and measurements. Total length (TL, cm), total (TW, g), gutted weights (GW, g) and Stomachs weights (g) were recorded for each

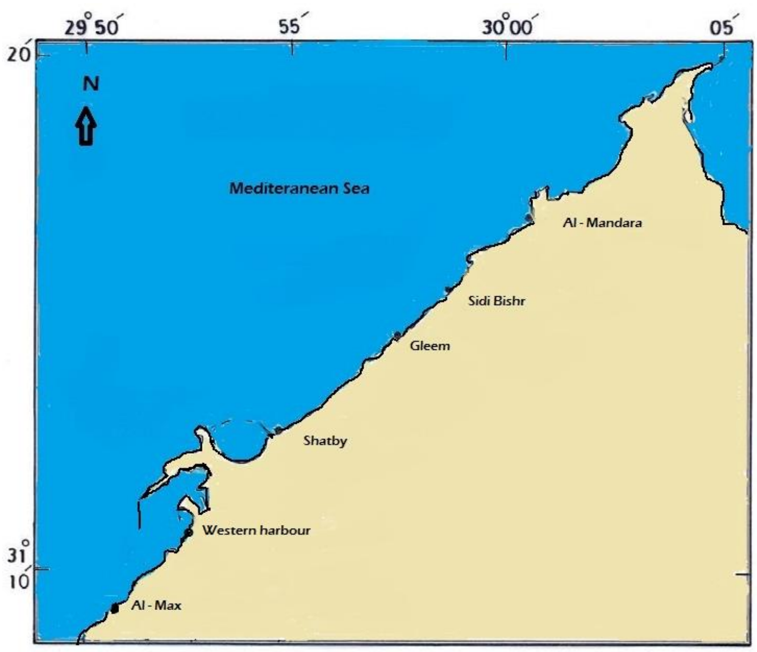

Figure 1. Studying area was included Beach area extends from El-Mandara to Al-Max East of Alexandria.

specimen.

Data Analysis

Biodiversity was calculated based on the formulae developed by Shannon's Index (H') (Shannon &Weaver, 1949), and Simpson's Index of Diversity (1 – D) (Simpson, 1949).

The dominance of each taxon in fish community was expressed as Index of relative dominance (IRD).

IRD = % Fi (%Wi + Ni%)

Where:

%F = number of hauls containing species i / total number of hauls * 100.

%W = weight of species i / total weight of all species * 100

%N = number of individuals of species i / total number of individuals * 100

%IRDi = 100 IRDi / n∑i=1 IRDi

Where n is the total number of taxa found in area.

Fullness index (FI) was calculated according to Berhaut (1973), FI = 100 $W^{/}$ / W, where $W^{/}$ is the weight of stomach contents and W is the gutted weight of the fish.

All collected data in the present study were subjected to Statistical analysis by using STATISTICA® software for Windows (Stat Soft, Inc., 1995).

Results

Communities' Level

The catches operations revealed that, fish community in beach area off Alexandria including 22 families, family Sparidae was dominated the catch formed 23.68% and Mugilidae occupied the second rank amounting 7.89% of total catch by number.

Species Composition

In total, 45species were recorded; only 9 species dominated the catch representing 81.41% by number and 60.89% by weight.

Siganus rivulatus Forsskål & Niebuhr, 1775was the most frequent species (87.5%) followed by *Diplodus sargus* (Linnaeus, 1758) (62.5%) and *Pagellus erythrinus* (Linnaeus, 1758) (62.5%). Fish abundance revealed that, *S. rivulatus* was most important species by number (41.83%) and by weight (31.82%), *D. sargus* was the second important fish by number (8.43%) and by weight (12.24%) followed by *Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817) comprising about 6.58% by number and 6.36% by weight. The index of relative dominance (%IRD) revealed that *S. rivulatus* contributing 54.47%, while *D. sargus* (10.92%) and *D. vulgaris* (8.20%) representing the second and third rank (Table 1).

Size Composition

The length frequency distribution of fishes captured from Beach area off Alexandria indicated that the majority of inhabited fishes are adults, have mean length bigger than 13.00 cm.

The catch of *S. rivulatus* was composed of fish in the length range 11.60 -22.00 cm having average length of 15.56 cm, most of them had the length of 14 -17 cm. The maximum length of *Lithognathus mormyrus* (Linnaeus, 1758) was 20.5 cm and has length range extend to 10.0-20.5 cm. Concerning of *P. erythrinus* fish, it has length range (11.0 - 18.0 cm) and mean length (14.14 cm), the majority of them measured from 13- 15 cm.

D. sargus is consist of fish have average length 15.99 cm, the majority of them measured from 14- 20 cm.

The length frequency distribution of *Sardinella aurita* Valenciennes, 1847 revealed that beach area fish are big has length range (11.0 - 18.0 cm) and mean length (13.72 cm).

Diplodus vulgaris fish has a wide length range from 12 to 23 cm with average length of 15.96 cm. *Boops boops* (Linnaeus, 1758)fishes showed limited length range from 11 to 16 cm, and the majority of fish are in length group 16 cm.

Scomber japonicas Houttuyn, 1782 contains fishes had length range of 7.00-17.00 cm. with mean length of 15.67 cm, the majority of them are small size fish measured from 8-10 cm.

Size composition of *Stephanolepis hispidus* (Linnaeus, 1766) from Beach area was composed of fish has wide length range from 10.0 cm to 22.0 cm, with average length 14.31 cm, the most frequency species was in length group 11 cm (Figure 2).

As regards to origin of species, the results showed that immigrant fishes in beach area included 10 of 45 species, these migrant species representing about half of the community by number (47.07%) and 38.34% by weight (Table 2) .

Seasonal variations in total catch and fish abundance by number of fish species inhabiting the Beach area revealed that, the highest catch value was obtained in winter decreased in autumn and spring to reach the minimum value in summer, while the maximum numerical abundance value were found in winter and gradually decreasing in spring and autumn to become less value also in summer (Figure 3).

Marbled spinefoot (*S. rivulatus*) was dominated catches of Beach area by number in all season, followed by *Scomber japonicas* Houttuyn, 1782(12.25%) in spring, *Boops boops* (Linnaeus, 1758)

Table 1. Numerical abundance (N), biomass (W), frequency of occurrence (F) and index of relative dominance (IRD) for fish species inhabiting the Beach area off Alexandria

	Abundance		Biomass		Occurrence			
Species	Number	%	W(g)	%	Frequency	%	IRD	%IRD
Siganus rivulatus	407	42.48	18607	32.21	7	87.5	6535.38	54.66
Siganus luridus	1	0.10	54	0.09	1	12.5	2.38	0.02
Diplodus sargus	82	8.56	7157	12.39	5	62.5	1309.38	10.95
Diplodus cervinus	12	1.25	1441	2.49	2	25	93.50	0.78
Diplodus vulgaris	64	6.68	3719	6.44	6	75	984.00	8.23
Pagellus erythrinus	40	4.18	1483	2.57	5	62.5	421.88	3.53
Pagrus pagrus	2	0.21	233	0.40	2	25	15.25	0.13
Lithognathus mormyrus	41	4.28	1770	3.06	3	37.5	275.25	2.30
Diplodus puntazzo	4	0.42	220	0.38	2	25	20.00	0.17
Boops boops	32	3.34	1121	1.94	3	37.5	198.00	1.66
Oblada melanura	2	0.21	146	0.25	1	12.5	5.75	0.05
Sardinella aurita	28	2.92	574	0.99	2	25	97.75	0.82
Scomber japonicus	37	3.86	371	0.64	1	12.5	56.25	0.47
Scomberomorus commerson	6	0.63	195	0.34	1	12.5	12.13	0.10
Serranus cabrilla	3	0.31	220	0.38	2	25	17.25	0.14
Epinephelus alexandrinus	2	0.21	85	0.15	2	25	9.00	0.08
Caranx crysos	9	0.94	1019	1.76	3	37.5	101.25	0.85
Stephanolepis hispidus	49	5.11	2598	4.50	4	50	480.50	4.02
Stephanolepis diaspros	7	0.73	375	0.65	2	25	34.50	0.29
Lagocephalus spadiceus	6	0.63	445	0.77	2	25	35.00	0.29
sphyraena chrysotannea	4	0.42	1263	2.19	4	50	130.50	1.09
Trigla lucerna	10	1.04	707	1.22	2	25	56.50	0.47
Terapon puta	*1*	0.10	38	0.07	1	12.5	2.13	0.02
Sciaena umbra	5	0.52	1693	2.93	2	25	86.25	0.72
Mullus barbatus	1	0.10	21	0.04	1	12.5	1.75	0.01
Mullus sermuletus	12	1.25	779	1.35	2	25	65.00	0.54
Mugle cephalus	1	0.10	282	0.49	1	12.5	7.38	0.06
Liza aurata	2	0.21	2220	3.84	1	12.5	50.63	0.42
Liza ramada	1	0.10	33	0.06	1	12.5	2.00	0.02
Scorpina porcus	3	0.31	412	0.71	2	25	25.50	0.21
Scorpina medrensis	1	0.10	34	0.06	1	12.5	2.00	0.02
Sparisoma cretense	16	1.67	1486	2.57	4	50	212.00	1.77
Plectorhinchus mediterraneus	10	1.04	605	1.05	4	50	104.50	0.87
Euthynnus alletteratus	9	0.94	1684	2.91	3	37.5	144.38	1.21
Trachurus mediterraneus	3	0.31	153	0.26	1	12.5	7.13	0.06
Dussumieria acuta	2	0.21	43	0.07	1	12.5	2.13	0.02
xyrichthys novacula	8	0.84	399	0.69	2	25	38.25	0.32
Sargocentron rubrum	16	1.67	1045	1.81	2	25	87.00	0.73
Uranoscopus scaber	*1*	0.10	204	0.35	1	12.5	5.63	0.05
Parablennius tentacularis	*7*	0.73	471	0.82	3	37.5	58.13	0.49
Seriola dumerili	*2*	0.21	1804	3.12	2	25	83.25	0.70
Sparisoma cretense	*7*	0.73	430	0.74	4	50	73.50	0.61
Citharus linguatula	1	0.10	30	0.05	1	12.5	1.88	0.02
Thalassoma pavo	*1*	0.10	27	0.05	1	12.5	1.88	0.02
Nemipterus japonicus	*1*	0.10	79	0.14	1	12.5	3.00	0.03

(14.93%) in summer, *D. sargus* (24.39%) in autumn and *D. vulgaris* (16.08%) in winter. The third rank was represented by *B. boops* and *S. aurita* (4.53%) in spring, while *L. mormyrus* was the third in summer (13.43%) and autumn (6.38%), but in winter this rank was represented by *P. erythrinus* (10.08%) (Table 3).

The Biological Indices

The results of Shannon's Index (H') and Simpson's dominance index (1-D) revealed that, fishes community inhabit in beach area in summer is more diverse than in others seasons, while the lowest one found in spring (Table 4).

Relation between relative abundance of different dominant species revealed significant positive correlation between abundances of *D. vulgaris* and *P. erythrinus* (r=0.98**), while *S. aurita* showed positive correlation with *B. boops* (r=0.99**) and significant negative correlation with *S. hispidus* (r=-0.89*) (Table 5).

Regarding to relation between fullness index and

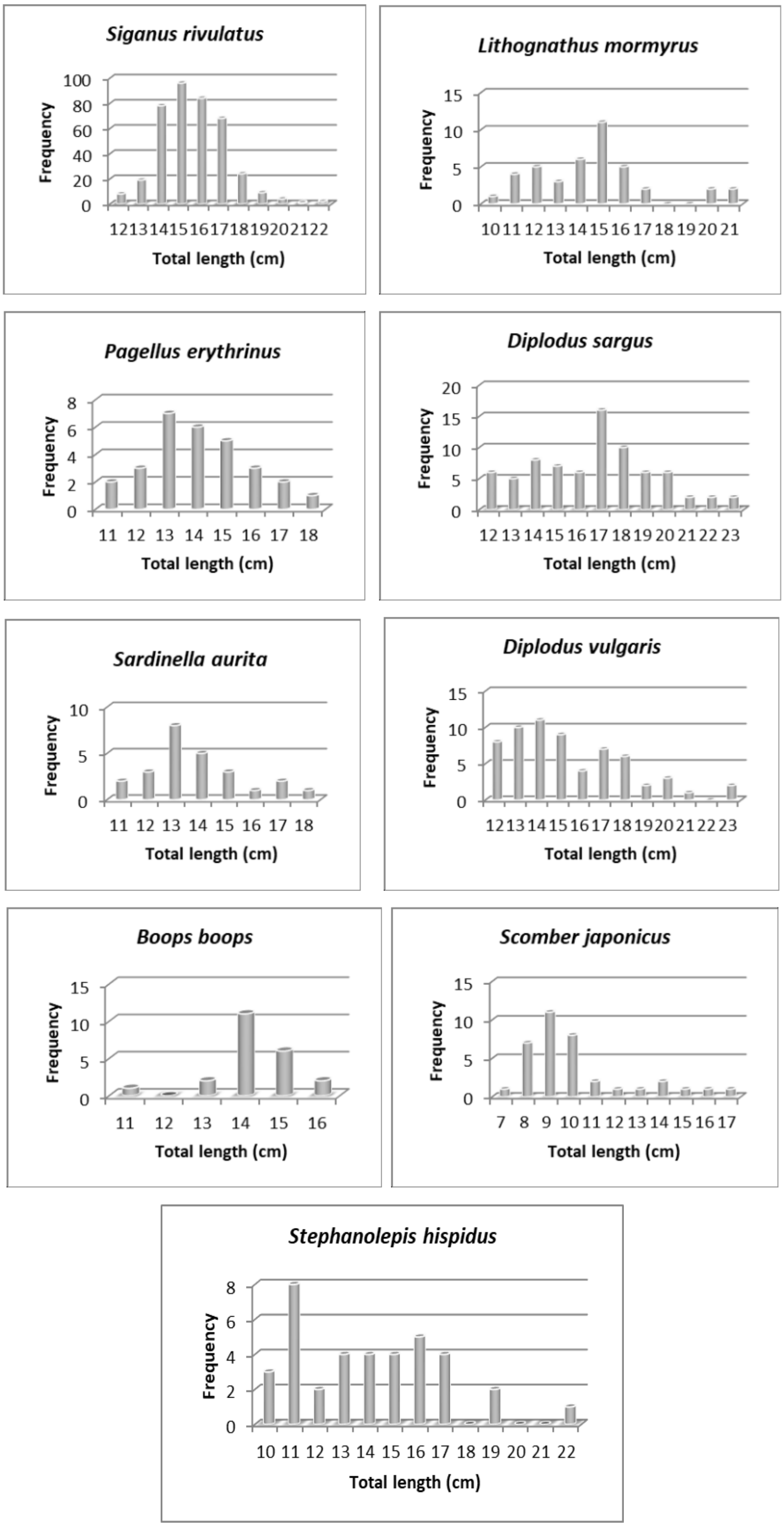

Figure2. Length frequency distributions of dominant fish species inhabit in Beach area off Alexandria.

numerical abundance of dominant fish species, it is obvious that, the Maximum values of both indices were found in the same seasons for *S. rivulatus* and *S. japonicas* in spring and for *S. hispidus* in winter, while *P. erythrinus* reavealed the maximum fullness index in autumn and and highst numerical abundance in winter. The other dominant species revealed that, there are no significant correlational relations between fullness index and numerical abundance (Figure 4).

Discussion

The Egyptian Mediterranean coast receives huge volumes of wastewaters every year through the coastal

Table 2. Observed mean (mean ± SD), average length, Origin and Status for different species caught in the Egyptian Mediterranean coast off Alexandria. Origin and Status (Golani et al., 2002 and http: //ww.fishbase.org.): RI= Red Sea immigrant; EA= Eastern Atlantic; MS= Mediterranean Sea; A= Atlantic Ocean; I-WP= Indo-West Pacific; IP = Indo Pacific

Species	Mean + SD	Range	Origin & Status
Siganus rivulatus	15.56± 1.68	11.60 -22.00	RI
Siganus luridus	15.5	–	RI
Diplodus sargus	15.99± 5.07	12.0 -23.0	EA & MS
Diblodus cervinus	16.50 ± 6.01	14.0 - 29.0	EA & MS
Diplodus vulgaris	15.96 ± 5.00	11.50 - 23.4	EA & MS
Diplodus puntazzo	14.85 ± 3.81	12.5-17.0	MS
Pagellus erythrinus	14.14 ± 1.59	11.0 - 18.0	EA & MS
Pagrus pagrus	14.77 ± 2.67	13.5-23.0	A & MS
Lithognathus mormyrus	14.45 ± 2.53	10.0-20.5	I-WP & MS
Boops boops	16.04 ± 5.19	11.5-20.0	EA & MS
Oblada melanura	16.25 ± 1.06	15.5 - 17.0	EA & MS
Sardinella aurita	13.72 ± 1.79	11.0 - 17.0	A & MS
Scomber japonicus	15.67 ± 5.15	7.0 - 17.0	IP& MS
Scomberomorus commerson	14.50 ± 1.45	13.5 - 16.5	RI
Serranus cabrilla	16.28 ± 4.37	16.0 - 19.0	EA & MS
Epinephelus alexandrinus	19.00 ± 2.83	17.0 - 21.0	EA & MS
Caranx crysos	21.23 ± 2.07	16.0 - 22.8	EA & MS
Stephanolepis hispidus	14.31 ± 2.92	10.0 - 22.0	A & MS
Stephanolepis diaspros	13.50 ± 2.50	11.0 - 18.0	RI
Lagocephalus spadiceus	18.04 ± 2.95	15.0 - 22.0	RI
Sphyraena chrysotannea	43.98+ 25.05	16.5- 84.0	RI
Trigla lucerna	18.30+ 2.58	15.0- 22.0	EA & MS
Terapon puta	13.00		RI
Sciaena umbra	29.00+ 9.88	21.0- 41.0	EA & MS
Mullus barbatus	21.00	–	EA & MS
Mullus sermuletus	16.86+ 2.30	12.0- 19.0	EA & MS
Mugil cephalus	32.00	–	EA & MS
Liza aurata	31.12+ 5.88	23.0- 37.0	EA & MS
Liza ramada	15.00	–	EA & MS
Scorpaena porcus	18.77+ 2.80	17.0- 22.0	EA & MS
Scorpaena maderensis	13.00		EA & MS
Sparisoma cretense	15.97+ 4.95	13.3- 24.5	EA & MS
Plectorhinchus mediterraneus	14.86+ 3.25	10.5- 19.7	EA & MS
Euthynnus alletteratus	20.06+ 10.89	12.0- 39.0	EA & MS
Trachurus mediterraneus	14.67+ 5.69	10.0- 21.0	EA & MS
Dussumieria acuta	14.00+ 0.71	13.5- 14.5	RI
Xyrichthys novacula	16.36+ 4.50	13.0- 18.0	EA & MS
Sargocentron rubrum	14.00	–	RI
Uranoscopus scaber	14.00	–	EA & MS
Parablennius tentacularis	15.00+ 3.54	12.5- 17.5	EA & MS
Seriola dumerili	42.65+ 0.07	42.6- 42.7	I-wP, A&MS
Sparisoma cretense	15.97+ 4.95	13.3- 24.5	EA & MS
Citharus linguatula	13.00	–	EA & MS
Thalassoma pavo	13.00	–	EA & MS
Nemipterus japonicus	18.00	–	RI

lagoons and from other land-based effluents. The continuous discharges polluted water, caused massive development of algal blooms, and gradually deteriorated the water quality; Zakaria, Radwan, and Said (2007) had also illustrated the effect of salinity changes and their influence on zooplankton abundance, which caused changing in fish community structure.

The impact of pollutions and overfishing led to continues decrease of species number in beach area. Whereas, El-Mex Bay is considered as one of the most polluted coastal regions in the Mediterranean Sea. It has been continuously subjected to several severe pollution problems (Dorgham, 2011; Hendy, 2013). Furthermore, increase fishing effort, illegals fishing gear such as operation by the beach seine and the extensive fishing in the spawning grounds led to decline the annual commercial catch from the Egyptian Mediterranean waters (El-Karashily & Saleh, 1986).

These unsuitable conditions led to continues decrease of species number in beach area. In the present work, 22 family including 45 species in Beach

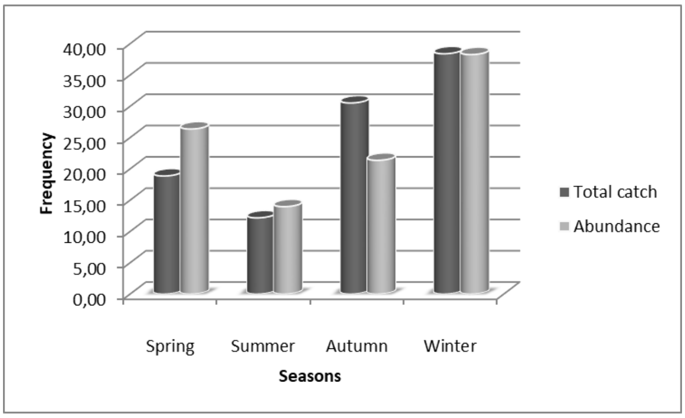

Figure 3. Seasonal variations in total catch and fish abundance by number of trammels net in Beach area off Alexandria.

Table 3. Seasonal variations in numerical abundance of fish species inhabiting the Beach area off Alexandria

Seasons	Spring		Summer		Autumn		Winter	
Species	Number	%	Number	%	Number	%	Number	%
Siganus rivulatus	170	67.19	37	27.61	81	37.85	119	33.24
Siganus luridus	1	0.40	0	0.00	0	0.00	0	0.00
Diplodus sargus	2	0.79	6	4.48	50	23.36	24	6.70
Diplodus cervinus	0	0.00	0	0.00	5	2.34	7	1.96
Diplodus vulgaris	4	1.58	1	0.75	3	1.40	56	15.64
Pagellus erythrinus	1	0.40	2	1.49	6	2.80	31	8.66
Pagrus pagrus	0	0.00	1	0.75	1	0.47	0	0.00
Lithognathus mormyrus	2	0.79	16	12.12	14	6.54	9	2.51
Diplodus puntazzo	0	0.00	3	2.24	0	0.00	1	0.28
Boops boops	11	4.35	20	14.93	0	0.00	1	0.28
Oblada melanura	0	0.00	2	1.49	0	0.00	0	0.00
Sardinella aurita	11	4.35	14	10.77	2	0.93	1	0.28
Scomber japonicus	29	11.55	6	4.48	0	0.00	2	0.56
Scomberomorus commerson	0	0.00	6	4.48	0	0.00	0	0.00
Serranus cabrilla	0	0.00	0	0.00	0	0.00	3	0.84
Epinephelus alexandrinus	1	0.40	0	0.00	0	0.00	1	0.28
Caranx crysos	1	0.40	0	0.00	6	2.80	2	0.56
Stephanolepis hispidus	2	0.79	2	1.52	12	5.61	31	8.66
Stephanolepis diaspros	0	0.00	1	0.75	0	0.00	6	1.68
Lagocephalus spadiceus	0	0.00	0	0.00	2	0.93	4	1.12
Sphyraena chrysotannea	0	0.00	0	0.00	3	1.40	1	0.28
Trigla lucerna	0	0.00	0	0.00	10	4.67	0	0.00
Terapon puta	0	0.00	0	0.00	0	0.00	1	0.28
Sciaena umbra	2	0.79	0	0.00	2	0.93	1	0.28
Mullus barbatus	0	0.00	1	0.75	0	0.00	0	0.00
Mullus sermuletus	0	0.00	0	0.00	5	2.34	7	1.96
Mugle cephalus	0	0.00	0	0.00	1	0.47	0	0.00
Liza aurata	0	0.00	1	0.75	1	0.47	0	0.00
Liza ramada	0	0.00	1	0.75	0	0.00	0	0.00
Scorpina porcus	3	1.19	0	0.00	0	0.00	0	0.00
Scorpina medrensis	1	0.40	0	0.00	0	0.00	0	0.00
Sparisoma cretense	4	1.58	0	0.00	0	0.00	12	3.35
Plectorhinchus mediterraneus	4	1.58	0	0.00	4	1.87	2	0.56
Euthynnus alletteratus	0	0.00	7	5.22	1	0.47	1	0.28
Trachurus mediterraneus	0	0.00	3	2.24	0	0.00	0	0.00
Dussumieria acuta	0	0.00	2	1.49	0	0.00	0	0.00
Xyrichthys novacula	0	0.00	0	0.00	1	0.47	7	1.96
Sargocentron rubrum	0	0.00	0	0.00	0	0.00	16	4.47
Uranoscopus scaber	0	0.00	0	0.00	0	0.00	1	0.28
Parablennius tentacularis	3	1.19	0	0.00	0	0.00	4	1.12
Seriola dumerili	0	0.00	0	0.00	1	0.47	1	0.28
Sparisoma cretense	0	0.00	0	0.00	3	1.40	4	1.12
Citharus linguatula	0	0.00	0	0.00	0	0.00	1	0.28
Thalassoma pavo	1	0.40	0	0.00	0	0.00	0	0.00
Nemipterus japonicus	0	0.00	0	0.00	0	0.00	1	0.28

Table 4. Seasonal variations in community indexes for fishes inhabiting in Beach area off Alexandria

	Spring	Summer	Autumn	Winter
Shannon's Index (H')				
H'	1.374	2.381	2.102	2.281
Hmax	2.944	2.944	3.173	3.497
Evenness	0.467	0.787	0.661	0.652
Simpson's Index (1 – D)	0.532	0.864	0.792	0.842

Table 5. Correlation matrix (r) between dominant fish species caught by trammels net off Alexandria

Species	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Siganus rivulatus (1)	1.00	-0.32	-0.28	-0.27	-0.77	-0.20	0.84	-0.27	-0.45
Diplodus sargus (2)	-0.32	1.00	-0.10	-0.52	-0.31	-0.56	-0.64	0.72	-0.45
Diplodus vulgaris (3)	-0.28	-0.10	1.00	-0.47	0.08	-0.50	-0.47	0.59	0.98**
Boops boops (4)	-0.27	-0.52	-0.47	1.00	0.78	0.99**	0.25	-0.58	-0.33
Lithognathus mormyrus (5)	-0.77	-0.31	0.08	0.78	1.00	0.73	-0.35	-0.37	0.26
Sardinella aurita (6)	-0.20	-0.56	-0.50	0.99**	0.73	1.00	0.31	-0.89*	-0.37
Scomber japonicus (7)	0.84	-0.64	-0.47	0.25	-0.35	0.31	1.00	-0.72	-0.56
Stephanolepis hispidus (8)	-0.27	0.72	0.59	-0.58	-0.37	-0.89*	-0.72	1.00	0.54
Pagellus erythrinus (9)	-0.45	-0.45	0.98**	-0.33	0.26	-0.37	-0.56	0.54	1.00

*. Correlation is significant at the 0.05 level
**. Correlation is significant at the 0.01 level

area were recorded, comparing with 41 species recorded in 1987 (Al-Sayes, Soliman, & Hashem, 1987), and 36 family including 63 species caught in coastal region in 2005 (Akel, 2005).

The surf-zone fish assemblages are usually dominated by few species (McFarland, 1963; Modde & Ross, 1981 & Esposito *et al.*, 2015). In agreement with these findings, the study coastal area is dominated by nine species, which makes up 80.17% of the total abundance. The few species dominated fish community in coastal area is composed of chiefly herbivorous (*S. rivulatus*), planktivorous (*S. aurita*) and planktophagous (*B. boops*), also adult transients between the surf-zone and open-sea environments, that feed mainly on benthic invertebrates (*P. erythrinus*, *S. hispidus*, *D. sargus*) and other fishes move inshore during specific periods (*L. mormyrus*, *D. vulgaris* and *S. japonicus*).

The exotic species 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 & Glaser, 1974) and the Egyptian coast (Wadie & Shenouda, 1985; Shenouda, 1986 & Bakhoum, 2013).

In the present study, immigrant fishes in Beach area included 10 of 45 species and representing about half of the community by number (47.07%). Moreover, immigrant *S. rivulatus* was the most frequent species in all seasons and become the most dominant species found in Beach area community. This finding is in agreement with Faltas & Akel (2003) on catch of Abu Qir bay East of Alexandria coast. They mentioned that Siganidae present the second frequent family in the catch. The success of Siganids shows a larger trophic or eco-physiological flexibility in the Mediterranean Sea (Hassan, Harmelin-Vivien & Bonhomme, 2003).

Sparid fishes showed highly abundance value in beach area, The results of Length frequency distributions explain that, the member of this family are matures come to Beach area for breeding, as a result *D. sargus* represent second rank in autumnsince its spawning season extended from December to May as reported by Morato, Afonso, Lourinho, Nash, and Santos (2003), while the maximum abundance of *D. vulgaris* found in winter, it can attributed to breeding, whereas spawning season for this species inEastern Mediterranean started from December and continued until January (Bauchot & Hureau,1986).

The present study revealed that species compassion of fish community differed from the fishing catch of 1975, as recorded by Al-Sayes *et al.* (1987), whereas mentioned catch are not composed of immigrant *S. rivulatus* and *L. mormyrus,* whichrepresent about 47% of numerical abundance of present study. Moreover, *S. aurita* which dominate abundance by number in fishing catch of 1975 become in ninth rank in this study. These variations can be attributed to impact of opening of the Suez Canal which led to great changes in the distribution of native and non–native fishes in Mediterranean waters (Bakhoum, 2007).

The spread of non-native species into the Egyptian Mediterranean coast depend on its adapted ability in host environment and food competition with relative species. Halim and Rizkalla (2011) gave a check-list of 42 immigrant Erythrean fish in Egyptian Mediterranean, whereas only 16 of these exotic species that have extended their distribution as far as the Aegean Sea (Golani *et al*., 2002). In addition to, the

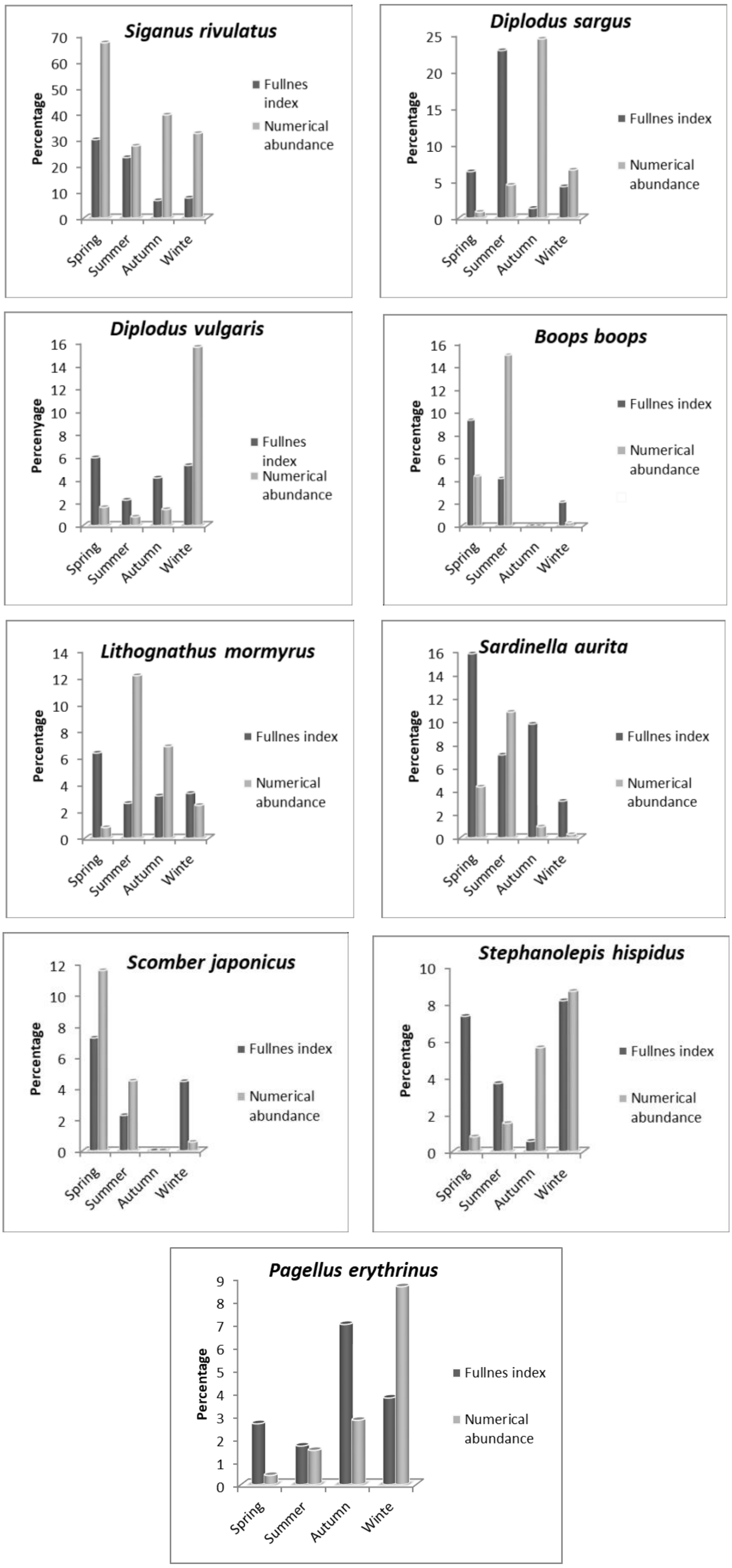

Figure4. Relations between fullness index and numerical abundance of dominant fish species inhabit in Beach area off Alexandria.

impact of construction of the Aswan High Dam due to the continuous decrease of the Nile water discharge (Fahmy *et al*., 1996). According to Wadie (1982) after the construction of the Aswan High Dam, the catch of pelagic fishes especially sardines have been dropped from 48% of the total catch from the south-eastern part of the Egyptian Mediterranean Sea to about 7%.

Numerical abundance of fish species inhabiting beach area were varied seasonally. This may be related to the hydrographic conditions prevailing during different months and the increasing fish abundance depend on appropriate conditions for spawning and food and feeding habits of this area fishes. Especially, planktonic feeder fishes which its nutrition heavily dependent on abundance of phytoplankton during the warm seasons. This in agreement with finding Hussein (2008) in her study in the same Beach area, whereas phytoplankton density showed the highest average density ($4.4x10^6$ unit/L) during March.

Length frequency distribution of dominant species indicates similar distributions for all examined species except *D. vulgaris* and *S. japonicas*, which would tend to be skewed towards smaller fish. It can explain by feeding habits of *D. vulgaris*, whereas according to Sala, and Ballesteros (1997) this species inhabiting rocky and sometimes sandy bottoms to depths of 160 m, but the young are sometimes found in sea grass beds, feeds on crustaceans, worms and mollusks. While, *S. japonicas* is seasonal migrant species, which Schooling by size, School of adults are most structured for overwintering and spawning in open water (Collette & Nauen, 1983).

The biological indices are important tool for the assessment and hence protection of biological diversity. The results of Shannon's Index (H') and Simpson's dominance index (1 – D) leads us to consider Beach area community more diverse in summer than in others seasons. It was accompanied with fish migration to surf-zone in the search for better conditions especially associated to the cyclical pattern of temperatures that significantly affects the species abundance and distribution (Santos & Nash, 1995; Esposito *et al*., 2015). Moreover, it may be as a result of the relative shallowness Beach area led to rise of water temperature during daytime, as compared with that of the open sea, especially during the summer season (Al-Sayes, 1971). In addition to, the influx of seasonal nursery juveniles of both resident and transient species, following their breeding season (Barreiros, Figna, Hostim-Silva, Santos, 2004; Selleslagh & Amara, 2007).

Feeding activity is strongly influenced by both biotic and abiotic environmental conditions and changes corresponding to variations in water temperature and food organisms (Sakamoto, 1982). Fullness index is a useful index for monitoring of condition factor (Oni, Olayemi, & Adegboye, 1983).Furthermore, it can explainsuccessful distribution of some immigrant fishes in new habitats (Bakhoum, 2007).

The viability and abundance of primary food sources and the opportunistic exploitation of superabundant food resources by teleosts could affect the assemblage structure of community. In the present study, the high number of fishes species inhabit in Beach area can explain by results of fullness index, which indicated that *S. rivulatus*, *S. hispidus*, and *S. japonicas* resort to this area for plenty of fish foods.

The present result indicated that, the positive correlation between *S. aurita* and *B. boops* for existence in Beach area can be attributed to their highest value of feeding intensity in spring, whereas *B. boops* fed mainly crustaceans & zooplankton (Anato & Ktari, 1983) and *S. aurita* also feeds mainly on zooplankton, especially copepods and Juveniles take phytoplankton (Bianchi, Carpenter, Roux, Molloy, Boyer, & Boyer, 1999). The negative correlation between S. *aurita* and *S. hispidus,* can explain by feeding habits, whereas *S. aurita* fed on phytoplankton which, pluming in spring, while *S. hispidus* search the substrate to bite at larger items or pick up small items, either animals or plants which can found in all seasons (Maigret & Ly, 1986).

The positive correlation between *D. vulgaris* and *P. elethrinus* can explain by that the mature fishes come to Beach area for spawning, where's, results revealed that the most size group of these species contains mature fishes. In addition to, According to Bauchot and Hureau (1986), the spawning season of these species in Eastern Mediterranean Sea occur in winter.

In this context, the present work is an attempt to examine and review the present status of fish community in the Egyptian Mediterranean Sea coast during recent years. These results may be useful in the management these fisheries in order to conserve the existing fish stock and to achieve better economic utilization by improve the present status of exploitation rate and environmental conditions.

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