Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 25 (5): 739 – 753 (2021)
www.ejabf.journals.ekb.eg

The update of immigrant Red Sea fish of Egyptian Mediterranean waters during (2013-2021)

Samir Ibrahim Rizkalla and Rasha Ali Heneish*

National Institute of Oceanography and Fisheries, NIOF, Egypt
***Corresponding author:** raheneish@gmail.com

ARTICLE INFO

Article History:
Received: Oct. 13, 2021
Accepted: Nov. 9, 2021
Online: Nov. 22, 2021

Keywords:
Red Sea fish,
Current status,
Lessepsian migration,
Mediterranean,
Egypt

ABSTRACT

The current study was conducted to address thirty nine immigrant fish species collected from the Red sea and recorded in previous studies in seven regions of the Egyptian Mediterranean waters during the period from 2013-2021. A total number of 13212 fish specimens were determined in this study. They were divided according to their importance in the fish markets into economic (18) and non-economic species (21). Thirteen new fish species were identified in the present work whereas 15 fish species in the checklist given by Halim and Rizkalla (2011) were not found in the study area within the study period. Fish occurrence was determined in the different studied regions (Port- Said, Damietta, Abu Qir, Alexandria, El-Agami, El- Dabaa and Marsa Matruh). On basis of occurrence, fish species were classified into rare, frequent and abundant. With an occurrence percentage of 49.1 including all fish species, Port- Said (North opening of Suez Canal) was recorded the highest among all studied regions, followed by Alexandria (41.9%), Abu-Qir (5.2%) and Marsa Matruh (3.7%). Considering species dominance in different regions; *Alepes djedaba* and *Siganus rivulatus* were the most dominant economic species found in Port Said, while *Nemipterus randalli* and *Sargocentrum rubrum* were abundant in Alexandria. In addition, *Nemipterus randalli* was detected in Abu-Qir area whereas in Marsa Matruh, *Upeneus pori* was the most abundant. In conclusion, this study was established to determine the distribution of Lessepsian species along the seven studied regions of the Egyptian Mediterranean waters during the period from 2013 to 2021.

INTRODUCTION

The Suez Canal is an artificial water channel constructed in 1869, connecting the Red Sea and the Mediterranean Basin **(SCA 2015)**. In the past, during their immigration from the South to the North, the immigrant fish species used to face two main problems; namely, the abnormal salinity of the Bitter Lakes **(Gruvel, 1936)** and the low salinity of the Mediterranean Sea, specifically in the north side of the canal, originated from the discharge of the Nile flood. However recently, an improvement has been witnessed in the levels of salinity in both sites due to the continuous dissolving in salt beds in the Bitter Lakes. This was attributed to the continuous works of deepening and widening the canal, beside the construction of the High Dam (1965- 1967) which prevents the Nile flood

from mixing with the sea water. Thus, the salinity level in the Bitter Lakes decreased, while an increase was detected in front of Port-Said (the North opening of the canal).

In 2014, the Egyptian government launched a national project establishing a new Suez Canal parallel to the existing one to connect the Bitter Lakes and West of El- Ballah with a total length of 72 Km (length of the navigation 35 km). The project targeted to increase the doubled parts of the Suez Canal to a percentage of 50 and minimize the waiting period for the transiting ships from one end to another **(SCA, 2015)**. Hence, an elevation in the water volume of both canals (old and new one) was observed leading to more fluent invasions of different species to the Mediterranean Sea. In this context, **Galili *et al.* (2015)** anticipated a wave of new bio invasion, whereas **Zenetos (2017)** reported a decreasing rate of introductions, which was not affected by the recent expansion of the Suez Canal.

Ichthyological studies (past and present) on immigrant Lessepsian fish species in the Egyptian Mediterranean waters

An early ichthyologist recorded three immigrant species; namely, *Equulites klunzingeri*, *Liza carinata*, and *Coryogalops ochetica* **(Norman, 1927)** and added that, the process of immigration through the Suez Canal after its opening for navigation started slowly. **Pansa and Sastry (1958)** recorded after nearly 30 years another species labeled *Siganus rivulatus*. This was followed by *Saurida undosquamis* **(El- Zarka and Koura, 1965)** and *Upeneus moluccensis* **(Ben-Tuvia, 1966)**. Ten years later, *Upeneus pori* and *Siganus luridus* were reported in the studies of **Bayouni (1972)** and **George (1972)**, respectively. In the year 1975, the *Dussumieria elopsoides* was recorded in the study of **Al- Kholy and El- Wakeel (1975)**. By **Ben-Tuvia (1977a, 1977b)** recorded four species: *Pelates quadrilineatus*, *Herklotsichthys punctatus*, *Terapon puta* and *Pomadasys stridens*. Furthermore, *Sphyraena chrysotaenia* was identified in the study of **Rizkalla (1985)**, while **Miller and Fouda (1986)** recorded *Silhouettea aegyptia*. The cartilaginous fish, *Himantura uarnak*, was reported by **Allam (1989)**. Twelve immigrant Red Sea fish species were added to the checklist of fish of the Egyptian Mediterranean waters **El-Sayed (1994)**, while **Rizkalla (1997)** reported ten Lessepsian species in the water of Alexandria. The Labridae species, *Pteragogus pelycus*, was mentioned in the study of **Gamee (2005)**. Noticeably, the third checklist of immigrant Red Sea fish species was produced in the study of **Halim and Rizkalla (2011)** including 44 alien species.

The aim of the present study was to spot highlights on researches conducted during the period from 2013- 2021, and hence, determine the abundance of each immigrant fish species in seven regions of the Egyptian Mediterranean waters (Port- Said, Damietta, Abu Qir, Alexandria, El-Agami, El- Dabaa and Marsa Matruh).

MATERIALS AND METHODS

A total number of 13212 specimens of non- indigenous fish species from the Red Sea were recorded in previous studies conducted during the period extending from 2013-2021.These species were captured by different fishing gears: bottom trawl nets (B.T., purse seine nets (P.S.), artisanal fishing gear nets (A. N.), beach seine nets (B.S.), gill nets (G.N.), and under water fishing gear by gun and spear (S.). Additional information from published works was also recognized in the current work.

Locations of the study regions (Port- Said, Damietta, Abu Qir, Alexandria, El-Agami, El- Dabaa and Marsa Matruh) are depicted in Figure 1 while sampling details (depth, fishing gear, and date of fish collection) are provided in Table 1.

Fishes in this study were divided into economic and non- economic species according to their importance in the fish markets. The abundance (A*) of each species in the seven regions of the Egyptian Mediterranean waters was classified according to their numbers as follows: numbers less than 10 (+) were classified as rare, number from 10 till 20 (++) were adjusted as frequent, whereas numbers more than 20 (+++) were identified as dominant.

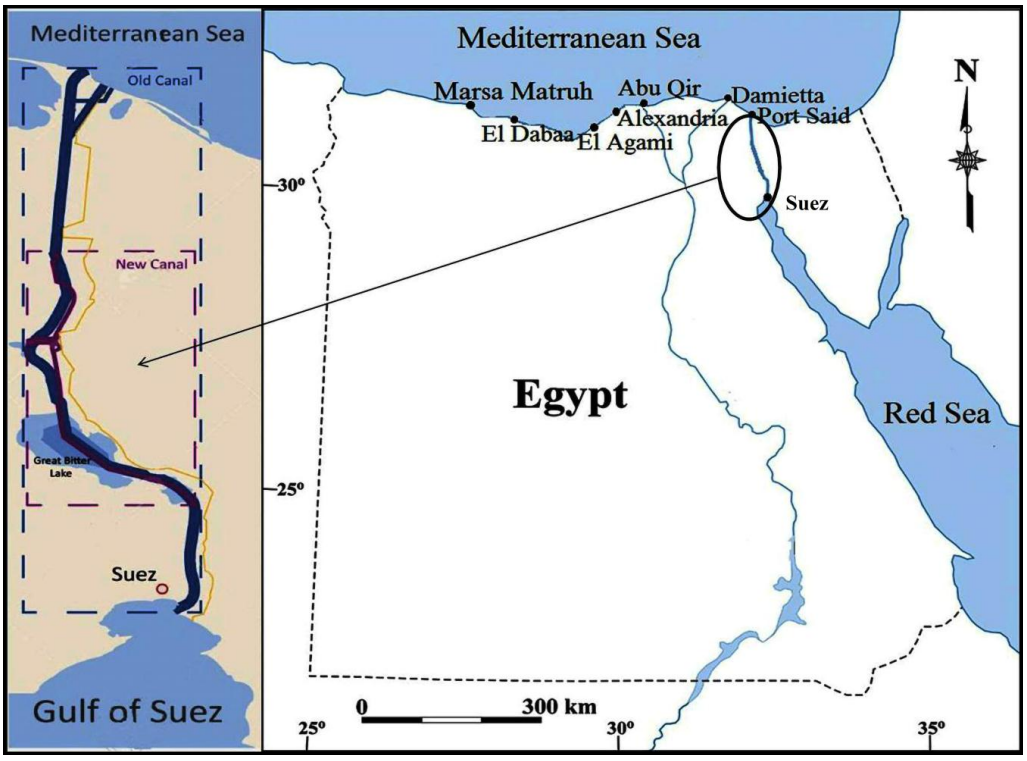

Fig. 1: A map for the study area.

Table 1: Location of the seven regions along the Egyptian Mediterranean waters (Port- Said, Damietta, Abu-Qir, Alexandria, Al- Agami, El-Dabaa, Marsa Matrouh) with their depths and fishing gears according to authors (2013- 2021)

Region	Locality	Depth	Fishing gear	Date of collection	Author
Port- Said	31.2221° N, 32.1535° E		B. T.	Sep. – Nov. 2013	**Akel and Rizkalla (2015)**
	31.2221° N, 32.1635° E	Less than 10m	B. T.	3 Feb. 2016	**Rizkalla and Akel (2016)a**
	31.2653° N, 32.3019° E		B. T.	2016	**Akel and Rizkalla (2017)b**
	31.2991° N, 32.2625° E		B. T.	10 Aug. 2017	**Stamouli *et al.* (2018)**
	31.2725° N, 32.2555° E		B. T.	Spring2017-Winter 2018	**Rageb *et al.* (2019)**
	31.2221° N, 32.1535° E		A. N.	autumn 2017-summer 2018	**Abdelhak *et al.* (2020)**
Damietta	31.4648° N, 31.4048° E			2020	**Deef (2021**)
Abu-Qir	31.3114° N, 30.0603° E	36- 54m	B. T.	seasonally 2014	**Rizkalla *et al.* (2016)**
	31.3114° N, 30.0603° E		P. S.	Aug. 2018	**Rizkalla and Heneish (2019)**
Alexandria	31.2001° N, 29.9187° E		B. T.	Dec. 2015	**Rizkalla and Akel (2015)**
	31.2001° N, 29.9187° E	5m	B. S.	31 Jan. 2016	**Rizkalla and Akel (2016)b**
	31.16° N; 30.10° E	40m	A. N.	31 Jan. 2016	**Mehanna *et al.* (2016)**
	31.2001° N, 29.9187° E	37- 54m	B. T.	8 Mar. 2017	**Akel and Rizkalla (2017)a**
	31.2001° N, 29.9187° E	–	A. N.	During 2016	**Farrag *et al.* (2018)**
	31.2001° N, 29.9187° E		G.N.	Winter 2018-Winter 2019	**Rageb *et al.* (2020)**
	31.12434° N, 29.5302° E	10 m	S.	27 Oct. 2019	**Al Mabruk *et al.* (2021)**
	31.1739° N, 30.0110° E	3 m	S.	30 Mar 2013	
	31.1727° N, 30.0117° E	9 m	S.	30 Mar 2017	
El- Agami	31.0988° N, 29.7667° E	36- 54m	B. T.	seasonally 2014	**Rizkalla *et al.* (2016)**
El-Dabaa – Marsa Matruh	31.0407° N, 28.2813° E	13 m	S.	16 Nov 2017	**Al Mabruk *et al.* (2021)**
	31.0512° N, 28.2612° E	12 m	S.	May 2019	
Marsa Matrouh	31.3543° N, 27.2373° E		B. T.		**Akel and Rizkalla (2017)a**
Marsa Matruh (EL-Garam Bay)	31.3543° N, 27.2373° E				**Kastanaevakis *et al.* (2020)**

Fishing gears:

- B.T. : Bottom Trawl
- G. N: Gill Net
- A. N: Artisanal Net (Trammel & gill net)
- P.S. : Purse-seine
- B.S. : Beach-seine
- S: Spear

RESULTS

Remarkably, fishing gears by bottom trawlers were used at depths ranging from 10-50 meters, and the beach- seine net operated at a depth of 5 m. The collection of immigrant fish started in 2013 and extended till 2021. Fishing by bottom trawlers goes through ten operations; three by artisanal operations (gill and trammel nets), four by gun and spear under water, and one operation for the followings: gill net, beach seine and purse seine nets. The list of Lessepsian immigrant fish species which invaded the coastal Egyptian Mediterranean waters are presented in Tables 2- 4. Overall, during the study period, thirty nine species were recorded in all regions18 of which were of economic value (46.7%) and 21 were regarded as of non- economic value (53.3%).

Fig. 2 shows the percentages of all individuals (economic and non- economic) in the seven regions under study. The recorded data revealed that Port Said was superior recording an occurrence of 49% for all fish species, while Alexandria was recorded the second with 41.9%. Furthermore, Abu Qir and Marsa Matruh were successively recorded the third and fourth, with percentages of 5.2 and 3.7, respectively.

On basis of fish classification into economic and non-economic, with respect to their value in fish markets, fish numerical existence was recorded in every region following the data of previous studies (from 2013- 2021. In this context, high percentage of non- economic species was detected in Port Said and Abu Qir (90.7% and 68.1%, respectively), while Alexandria recorded high percentage of economic species (87.4%).

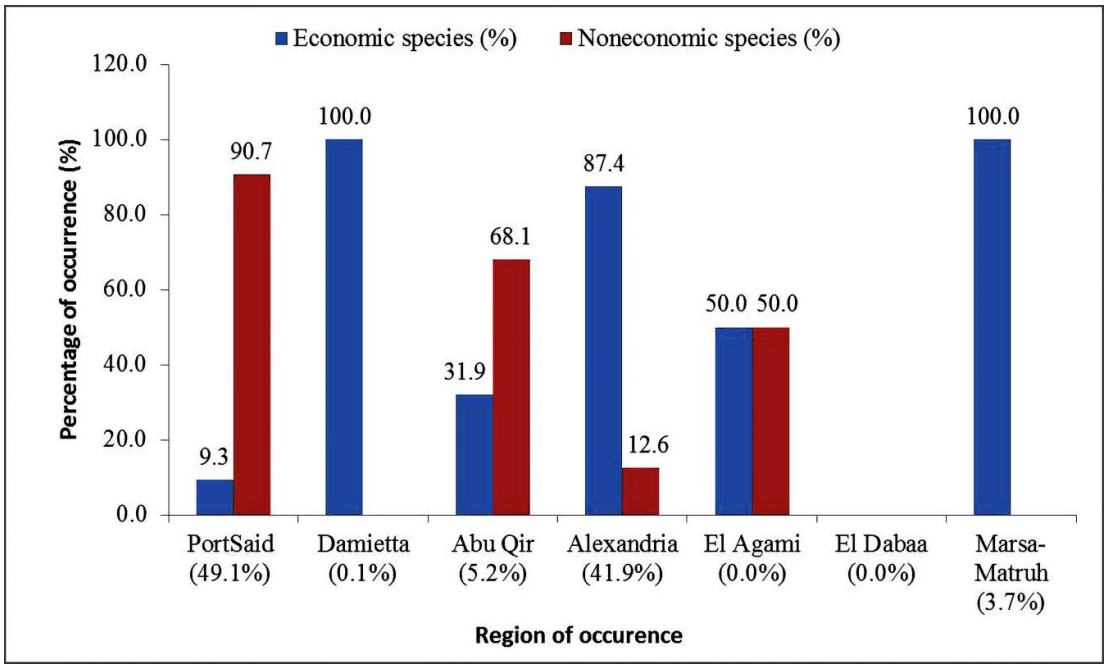

Fig. 2: Percentages of economic and non-economic species (Lessepsian) in the study regions of Egyptian Mediterranean waters (2013- 2021)

The distribution of Lessepsian species in the seven studied regions of the Egyptian Mediterranean waters was assessed in accordance with fish numbers, fishing gears used and abundance of individuals as follows:

Port Said (Table 2):

The dominance of six economic species among which *Siganus rivulatus* and *Alepes djedaba* were recorded being caught by artisanal and bottom trawl nets, respectively. On the other hand, sixteen non- economic species were observed of which *Herklotsichthys punctatus, Equulites kluzingeri, Terapon puta* dominated the bottom trawl catch, while other species were frequent or rare.

Table 2: Species composition of economic and non-economic Lessepsian ones (number of each individual (No.), abundance (A*), and fishing gear) obtained from Port Said region (Egyptian Mediterranean waters) as given authors during the period from 2013 to 2021

Authors	**Akel and Rizkalla (2015)**		**Rizkalla and Akel (2016)a**		**Akel and Rizkalla& (2017)b**		**Stamouli *et al.* (2018)**		**Rageb *et al.* (2019)**		**Abdelhak *et al.* (2020)**	
Fishing gear	B. T.		B. T.		B. T.		B. T.		B. T.		A. N.	
Economic Species	No.	A*	No.	A*			No.	A*	No	A*	No.	A*
Dussumieria elopsoides Bleeker, 1849									4	+		
Alepes djedaba (Forsskål, 1775)									543	+++		
Upeneus pori Ben-Tuvia & Golani 1989									31	++		
Nemipterus randalli Russell, 1986									2	+		
Siganus rivulatus Forsskål & Niebuhr, 1775									14	+	826	+++
Sphyraena chrysotaenia Klunzinger, 1884									12	+		
Non-economic Species	No.	A*	No.	A*	No	A*	No	A*	No	A*	No.	A*
Herklotsichthys punctatus (Rüppell, 1837)									3099	+++		
Apogonichthyoides pharaonis (Bellotti, 1874)									7	+		
Callionymus filamentosus Valenciennes, 1837									7	+		
Equulites klunzingeri (Steindachner, 1898)									1221	+++		
Terapon puta Cuvier, 1829									1251	+++		
Pelates quadrilineatus (Bloch, 1790)									1	+		
Cynoglossus sinusarabici (Chabanaud, 1931)									67	++		
Platycephalus indicus (Linnaeus, 1758)			4	+					7	+		
Plotosus lineatus									4	+		

(Thunberg, 1787)												
Stephanolepis diaspros Fraser-Brunner, 1940									88	++		
Ostorhinchus fasciatus (White, 1790)									6	+		
Jaydia smithi Kotthaus, 1970									3	+		
Bathygobius cyclopterus (Valenciennes, 1837)							1	+				
Sillago suezensis Golani, Fricke & Tikochinski, 2013	87	++										
Aulopareia unicolor (Valenciennes, 1837)					4	+						

- B.T. : Bottom Trawl Net
- A. N: Artisanal Net

Alexandria (Table 3):

In this water area, the dominance of nine economic species were determined in which *Nemiptrus randalli* was caught by bottom trawlers, while *Sargocentron rubrum* was caught by artisanal nets and *Siganus rivulatus* was detected in beach seine nets. Furthermore, ten non-economic species were depicted of which *Synchiropus sechellensis* dominated the bottom trawling catches, whereas three species were frequent in their abundance and eight species were rare in this region.

Table 3: Species composition of economic and non-economic Lessepsian ones (number of each individual (No.), abundance (A*), and fishing gear) obtained from Alexandria region (Egyptian Mediterranean waters) as given authors during the period from 2013 to 2021.

Author	**Rizkalla and Akel (2015)**		**Rizkalla and Akel (2016)b**		**Mehanna *et al.* (2016)**		**Akel and Rizkalla (2017)a**		**Farrag *et al.* (2018)**		**Rageb *et al.* (2020)**		**Al Mabrouk *et al.* (2021)**	
Fishing gear	B.T.		B.S.		A. N.		B. T.		A. N.		G.N.		S.	
Economic Species	No.	A*	No.	A*	No	A*	No.	A*	No.	A*	No.	A*	No.	A*
Nemipterus randalli Russell, 1986	69	++					3370	+++			93	++		
Siganus rivulatus Forsskål & Niebuhr, 1775	1	+	92	++							24	++		
Siganus luridus (Rüppell, 1829)											2	+		
Upeneus moluccensis (Bleeker 1855)	98	++					30	++						
Upeneus pori Ben-Tuvia &	27	++					130	+++						

Golani 1989														
Sargocentron rubrum (Forsskål, 1775)									814	++ +	60	++		
Parupeneus frosskali (Fourmanoir & Gue´ze´, 1976)					1	+								
Sphyraena flavicauda Rüppell, 1838											1	+		
Alepes djedaba (Forsskål, 1775)											1	+		
Non-economic Species	No.	A*	No.	A*	No	A*	No.	A*	No.	A*	No.	A*	No.	A*
Apogonichthyoides pharaonis (Bellotti, 1874)							15	+						
Callionymus filamentosus Valenciennes, 1837							10	+						
Equulites klunzingeri (Steindachner, 1898)							30	++						
Jaydia smithi Kotthaus, 1970							10	+						
Bathygobius cyclopterus (Valenciennes, 1837)							55	++						
Synchiropus sechellensis Regan, 1908							442	+++						
Herklotsichthys punctatus (Rüppell, 1837)			21	++							4	+		
Stephanolepis diaspros Fraser-Brunner, 1940											9	+		
Pomacanthus maculosus (Forsskål, 1775)													1	+
Abudefduf vaigiensis (Quoy & Gaimard, 1825)													1	+

- B.T. : Bottom Trawl Net fishing gear
- G. N: Gill Net fishing gear
- B.S. : Beach-seine Net fishing gear
- S.: Spear fishing gear
- A. N: Artisanal Net fishing gear

Abu-Qir, Damietta, El- Agami, El Dabaa and Marsa Matruh (Table 4):

Eight economic species were recorded in the water area of Abu Qir, where *Nemiptrus randalli* was the most dominant caught by bottom trawl nets. While, *Callionymus falimentosus* and *Equulites kluzingeri* were the more dominant non-economic species caught by bottom trawls among six recorded in the mentioned area.

Furthermore, economic species, such as *Upeneus pori* caught by bottom trawlers, was found in Marsa Matruh. On the other hand, rare species were detected in Damietta, El- Agami and El Dabaa.

Table 4: Species composition of economic and non-economic Lessepsian ones (number of each individual (No.), abundance (A*), and fishing gear) obtained from (Damietta, Abu- Qir, El- Agami, El- Dabaa, and Marsa Matruh) regions (Egyptian Mediterranean waters) as given authors during the period from 2013 to 2021.

Region	**Damietta**		**Abu- Qir**				**El- Agami**		**El- Dabaa**		**Marsa Matruh**			
Author	**Deef (2021)**		**Rizkalla *et al.* (2016)**		**Rizkalla and Heneish (2019)**		**Rizkalla *et al.* (2016)**		**Al Mabrouk *et al.* (2021)**		**Akel and Rizkalla (2017)a**		**Kastanaevakis *et al.*(2020)**	
Fishing gear			B. T.		P. S.		S.		B. T.		*		*	
Economic Species	No	A*	No	A*	No.	A*	No	A*	No.	A*	No.	A*	No.	A*
Nemipterus randalli Russell, 1986			112	+++										
Siganus luridus (Rüppell, 1829)			1	+							10	+		
Siganus rivulatus Forsskål & 1775			1	+							15	+		
Scomberomorus commerson (Lacepède 1800)					1	+								
Upeneus moluccensis (Bleeker, 1855)			80	++										
Upeneus pori Ben-Tuvia & Golani 1989			1	+			1	+			475	+++		
Fistularia commersonii Rüppell, 1838			22	++										
Sphyraena chrysotaenia Klunzinger, 1884			1	+										
Sargocentron spinosissimum (Temmin et Schlegel, 1843)	8	+												
Sargocentron tiereoides (Bleeker, 1853)	12	+												
Sargocentron rubrum (Forsskål, 1775)													*	*

Non-economic Species	No	A*	No	A*	No.	A*	No.	A*	No.	A*	No.	A*	No.	A*
Apogonichthyoides pharaonis (Bellotti, 1874)			17	++			1	+						
Terapon puta Cuvier, 1829			3	+										
Callionymus filamentosus Valenciennes, 1837			305	+++										
Pempheris vanicolensis Cuvier, 1831			18	++										
Lagocephalus sceleratus (Gmelin, 1789)			19	++										
Equulites klunzingeri (Steindachner, 1898)			105	+++										
Pomacanthus imperator (Bloch, 1787)									1	+				
Heniochus intermedius Steindachner, 1893									1	+				

- B.T. : Bottom Trawl Net fishing gear
- P. S.: Purse seine Net fishing gear
- S. : Spear fishing gear
- (*): the number not recorded

DISCUSSION

Considerable impacts on marine biodiversity were recognized due to climate changes and the construction of the Suez Canal. In this context, the Mediterranean Sea has witnessed an invasion of alien species (Lessepsian migration) from the Red Sea **(Heneish, 2016; Castellanos-Galindo *et al.*, 2020)**.

Golani *et al.* (2016) recorded one hundred invaders of Lessepsian fish species in the Mediterranean Sea. In the present study, thirty nine species penetrating the Egyptian Mediterranean waters were observed in seven regions of the coast during the period from 2013- 2021. Eighteen species were of economic value, while twenty one species were of non-economic. These Lessepsian fishes were caught using different fishing gears (bottom trawl nets, artisanal nets (trammel and gill nets), gill nets, purse- seine nets, beach- seine nets and fishing under water by gun and spears.

Remarkably, Siganus *rivulatus* and *Alepes djedaba* were the dominant species recognized in the region of Port Said, and were caught by artisanal nets and bottom trawls, respectively. On the other hand, *Nemipterus randalli* dominated the water area of Abu- Qir and Alexandria and was caught by bottom trawls. *Sargocentrom rubrum* species were dominated in Alexandria region caught by artisanal nets. With respect to non-economic species, *Herklotsichthys punctatus*, *Equulites kluzingeri*, *Terapon puta* were dominant in Port- Said, *Synchiropus sechellensis* in Alexandria, *Callionymus filamentosus* and *Equulites kluzangeri* in Abu Qir, and all were caught by bottom trawls. In addition, four specimens of *Plotosus lineatus* were caught using bottom trawl in the water area of Port Said. **Streftraris and Zenetos (2006)** considered this species as one of the 100 worst harmful invasions to human.

The percentages showing high fish species occurrence in the Red Sea, specifically in Port Said (49.17%) and Alexandria (41.9%) could be attributed to the fact that the former is the gateway for the dispersion of Lessepsian species to all parts of the Levant basin (east, west and north). Accordingly, this region attracts the attention of the Egyptian researchers to start in collecting data given by different fishing gears in this area. Considering to the water area of Alexandria, the high occurrence may be related to the vast and wide nature of this area, extending between Alexandria and the two Nile Delta branches (Rosetta and Damietta), which is more suitable for the operations of most fishing gears.

It was noted that, the lowest percentage of alien species occurrence was recorded west Alexandria (El- Agami, El- Dabaa and Marsa Matruh). This phenomenon may be due to the presence of narrow continental shelf with many rocks and to the far sea depths which hinder the bottom trawlers from operating in this area.

Andaloro and Azurro (2004) assessed that, the Lessepsian fishes prefer the Eastern region of the Mediterranean compared to the Western region as the mean temperature of the former is 21˚C and the value of salinity is 39‰, compared to 15˚C and 36‰, respectively in the latter (the Atlantic Ocean). This may explain why the Indo-Pacific fish couldn't remain in the western region **(Golani *et al.*, 2002)**. In addition, **Avsar (1998)** reported that the increase of Lessepsian immigrants in the Eastern Mediterranean could be explained by the presence of hydrographic and bio- ecological conditions which are identical to those in the Red Sea.

The present study notably revealed the absence of fifteen species given in the checklist of **Halim and Rizkalla (2011)**.The missing species were: [*Himantura* (Gmelin, 1789); *Atherinomorus lacunosus* (Forster, 1801); *Epinephelus malabaricus* (Bloch & Schneider, 1801); *Parexocoetus mento* (Valenciennes, 1847); *Rastrelliger kanagurta* (Cuvier, 1816); *Pteragogus trispilus* (Randall, 2013); *Sebastapistes nuchalis* (Günther, 1874); *Pomadasys stridens* (Forsskål, 1775); *Oxyurichtys petersi* (Klunzinger, 1871); *Coryogalops ocheticus* (Norman, 1927); *Spratelloides delicatulus* (Bennett, 1832); *Tylosurus choram* (Rüppell, 1837); *Hemiramphus far* (Forsskål, 1775); *Liza carinata* (Valenciennes, 1836) and *Silhouettea aegyptia* (Chabanaud, 1933)].

The afore- mentioned disappearance of those specific species may be attributed to either their rare existence during the previous period (2013- 2021) or their inability to continue living in the new environment of the Egyptian Mediterranean waters.

Simultaneously, thirteen new Erythrean species were documented during the years extending from2013 to 2021.; namely, *Parupeneus forsskali; Ostorhinchus fasciatus; Jayda smithi; Plotosus lineatus; Bathygobius cyclopterus; Auleparia unicolor; Synchiropus sechellensis; Heniochus intermedius; Pomacanthus maculosus; Pomacanthus imperator; Abudefduf vaigiensis Sargocentron spinosissimum* and *Sargocentron tiereoides.*

It is worth noting that, the present study did not include the species that invaded the Northern Egyptian Lakes (*Edku, Burullus,* and *Manzalla*). Moreover, on basis of the current observations, it is worthy to mention that some species caught by gill nets

(*Fistularia commersonii)* and purse seine (*Scomberomorus commerson*) became more abundant in the fish markets of Alexandria. Generally, the present study was the first to determine the distribution of Lessepsian species along seven regions of Egyptian Mediterranean waters during the studied period (2013- 2021).

REFERENCES

Abdelhak, M.E.; Madkour, F.; El-Ganainy, A.; Abu El-Regal, M. and Ismail, M.(2020). Comparative study on morphometric relationships and condition factor of *Siganus rivulatus* inhabits the Red Sea, Suez Canal and the Mediterranean Sea, Egypt. *Egyptian Journal of Aquatic Biology and Fisheries*, 24 (7- Special issue): 955-972. DOI: 10.21608/ ejabf. 2020.131399

Akel, E.H.Kh. and Rizkalla, S.I., (2015). A contribution to the fishery biology of an-immigrant new species, *Sillago suezensis* (Golani, Fricke & Tikochinski, 2014) (Family Sillaginidae), ın the Egyptian Mediterranean Waters off Port Said. *International Journal of Innovative Studies in Aquatic Biology and Fisheries*, 1 (1): 38–45.

Akel, E.H.Kh. and Rizkalla, S.I., (2017)a. Demersal fisheries and economic fish species from west Egyptian Mediterranean (Alexandria- Matrouh) technical report for the period at National Institute of Oceanography and Fisheries (Fishery Lab), 14 pp.

Akel, E.H.Kh. and Rizkalla, S.I., (2017)b. A first Record of *Aulopareia unicolor* (Valenciennes, 1837) (Family: Gobiidae) in the Mediterranean Sea, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries*, 21(2): 63-66. DOI: 10.21608/ejabf.2017.3533

Al Mabruk, S.A.; Abdulghani, A.; Nour, O.M.; Adel, M. and Crocetta, F. et al., (2021). The role of social media in compensating for the lack of field studies: five new fish species for the Mediterranean Egypt. *Journal of Fish Biology*, 99(2): 1–6. https://doi.org/10.1111/jfb.14721

AL-Kholy, A.A. and El-Wakeel, S.K. (eds) (1975). Fisheries of the South-Eastern Mediterranean Sea along the Egyptian coast. Soviet-Egyptian Expedition 1970- 1971. *Bulletin of the National Institute of Oceanography and Fisheries*, 5: 1–279

Allam, S.M. (1989). *Revision of the order Hypotremata along the Mediterranean coast off Alexandria with special reference to the family Dasyatidae*. Ph.D. Thesis, Faculty of Science, University of Alexandria, Egypt.

Andaloro, F. and Azzurro, E. (2004). The Sicily channel, a crossroad between Atlantic and Indo-Pacific Worlds. In *13th International Conference on Aquatic Invasive Species. 20–24 September, 2004, Ennis, County Clare Ireland. Abstract Book*, 192pp.

Avşar, D. (1998). Physico-Chemical Characteristics of the Eastern Mediterranean in Relation to Distribution of the New Scyphomedusae (*Rhopilema nomadica*). *Turkish Journal of Zoology*, 23: 605-616

Bayoumi, A.R. (1972). Recent biological investigations in the Red Sea along the A.R.E. coasts. 1. On some demersal fishes of economic importance from the Red Sea with notes on migration of fish through the Suez Canal. *Bulletin of the National Institute of Oceanography & Fisheries*, 2: 159-183.

Ben-Tuvia, A. (1966). Red Sea fishes recently found in the in the Mediterranean. *Copeia*, 2: 254-275.

Ben-Tuvia, A. (1977)a. New records of Red Sea immigrants in the eastern Mediterranean. *Cybium*, 3: 95-102.

Ben-Tuvia, A. (1977)b. Occurrence of Red Sea fishes *Herklotsichthys punctatus*, *Autisthes puta* and *Rhonciscus stridens* in the eastern Mediterranean. *Israel Journal of Zoology*, 25(4): 212-213.

Castellanos-Galindo, G.G.; Robertson, D.R. and Torchin, M.E., (2020). A new wave of marine fish invasions through the Panama and Suez Canals. *Nature Ecology & Evolution* 4(11): 1444–1446. https://doi.org/10.1038/s41559-020-01301-2

Deef, L.E.M. (2021). First record of two squirrelfish, *Sargocentron spinosissimum* and *Sarogcentron tiereoides* (Acytinopterygii, Beryciformes, Holocentridae) from the Egyptian Mediterranean coast. *Acta Ichthyologica et Piscatoria*, 51(1): 107- 112. https://doi.org/10.3897/aiep.51.63216

El Sayed, R.S. (1994). Check-list of Egyptian Mediterranean fishes. *Bulletin of the National Institute of Oceanography and Fisheries*, 77 + IX pp. Alexandria, Egypt.

El-Zarka, S. and Koura, R. (1965). Seasonal fluctuations in the production of the important food fishes of the U.A.R. waters of the Mediterranean Sea. *Alexandria Institute of Hydrobiology & Fisheries, Notes and memoirs.* NO. 74, 69 pp.

Farrag, M. M.S.; Abouel Fadl, K.Y.; Al Abssawy, A.N.; Toutou, M.M.M. and El-Haweet, A.A.K., (2018). Fishery biology of Lessepsian immigrant squirrelfishes *Sargocentron rubrum* (Forsskål, 1775), Eastern Mediterranean Sea, Egypt, The *Egyptian Journal of Aquatic Research*, 44 (4): 307-313. https://doi.org/10.1016/j.ejar.2018.10.003

Galil, B. S.; Boero, F.; Campbell, M. L.; Carlton, J. T. and Cook, E., *et al.* (2015). 'Double trouble': the expansion of the Suez Canal and marine bioinvasions in the Mediterranean Sea. *Biol Invasions*, 17(4): 973-976. https://doi.org/10.1007/s10530-014-0778-y

Gamee, F.M. (2005). *Taxonomical and biological studies on some representatives of Family Labridae in the Egyptian Mediterranean waters off Alexandria*. PhD Thesis, Faculty of Science, Alexandria University, 235 pp.

George, C.J. (1972). Notes on the breeding and movements of the Rabbit fishes, *Siganus rivulatus* (Forssk, 1775) and *S. luridus* Rüppell, in the coastal waters of the Lebanon. *Annali Del Museo Civico Di Storia Naturale De Genova*, 79: 32-44.

Golani, D.; Orsi Relini, L.; Massutí, E. and Quignard, J.-P. (2002). *CIESM Atlas of Exotic Species in the Mediterranean*. Volume 1. Fishes. F. Briand (ed.). 256 pages. CIESM Publishers, Monaco. ISBN: 92-990003-1-X

Golani, D.; Orsi Relini, L.; Massutí, E. and Quignard, J.-P. (2016). *CIESM e Atlas of Exotic Fishes e List* [WWW Document]. http://www.ciesm.org/atlas/appendix1.html.

Gruvel, A. (1936). Contribution à l'étude de la Bionomie générale et de l'exploitation de la faune du Canal de Suez. *Mémoires présentés à l'Institut d'Égypte*, 29: 1-255.

Halim, Y. and Rizkalla, S.I. (2011). Aliens in Egyptian Mediterranean waters. A check-list of Erythrean fish with new records. *Mediterranean Marine Science*, 12 (2): 479–490.

Heneish, R.A. (2016). *A study on the taxonomy and fisheries biology for some goat fish (Family: Mullidae) from the Gulf of Suez*. Ph.D. Thesis, Faculty of Science, Suez Canal University.

Katsanevakis S.; Poursanidis D.; Hoffman R. and Rizgalla J, *et al.*, (2020). Unpublished Mediterranean records of marine alien and cryptogenic species. *BioInvasions Records*, 9(2): 165-182. https://doi.org/10.3391/bir.2020.9.2.01

Mehanna, S.; Usama, M. and Mansour, E. (2016). First occurrence of the Red Sea goatfish, *Parupeneus forsskali* (Fourmanoir Guz, 1976) in the coastal waters of Egyptian Mediterranean Sea. *International Journal of Fisheries and Aquaculture*, 8: 94-97. DOI: 10.5897/IJFA2016.0556

Miller, P.J. and Fouda, M. (1986). Notes on the biology of a Red Sea goby *Silhouettea aegyptia* (Chabanaud, 1933) (Teleostei,Gobiidae). *Cybium*, 10 (4): 395-409.

Norman, J.R. (1927). Zoological results of the Cambridge Expedition to the Suez Canal. *Transactions of the Zoological Society of London*, 22: 375-389.

Panse, V.G. and Sastry, K.V.R. (1958). *Sample surveys for improvement of fishery statistics in Egypt*. FAO, Rome, 96 pp. (Polycopié).

Ragheb, E.A; Akel, E.H. Kh. and Rizkalla, S.I. (2019). Analyses of the non-target catch from the Egyptian Mediterranean trawlers, off Port Said. *Egyptian Journal of Aquatic Research*, 45 (3): 239-246. https://doi.org/10.1016/j.ejar.2019.07.003

Ragheb, E.A.; Heneish, R.A.; Rizkalla, S.I. and Wagih, M.A.H., (2020). Fisheries of gillnets along the Egyptian Mediterranean coast, off Alexandria *Technical report for the period at National Institute of Oceanography and Fisheries (Fishery Lab)* , 24 pp.

Rizkalla, S.I. (1985). *Fishery biology studies on Family Sphyraenidae in the Egyptian Mediterranean waters.* M.Sc. Thesis. Faculty of Science, University of Alexandria

Rizkalla, S.I. (1997). New records of Lessepsian fishes found in the Egyptian Mediterranean waters, pp. 464-470. In: Proceedings of the 7th International Conference on "Environmental Protection is a Must", Alexandria, Egypt.

Rizkalla, S.I. and Akel, E.H.Kh. (2015). Analysis of bottom trawls catch obtained by commercial vessel (Said Shokr) during winter season of Alexandria, Mediterranean Sea, Egypt *Technical report at the National Institute of Oceanography and Fisheries (Fisher biology)*, pp. 14- 25.

Rizkalla, S.I. and Akel, E.H.Kh. (2016)a. A contribution to Biometric Analysis and Length-weight relationship of *Platycephalus indicus* (Linnaeus, 1758) obtained off Port Said (Egyptian Mediterranean waters). *Acta Velit*, 3 (1): 96-107.

Rizkalla, S.I. and Akel, E.H.Kh. (2016)b. Analysis of beach seine net catch obtained from western harbor of Alexandria Mediterranean Sea, Egypt. *Technical report at the National Institute of Oceanography and Fisheries (Fisher biology)*, pp. 3- 13.

Rizkalla, S.I. and Heneish, R.A. (2019). A comparative study on the morphometric characters of the first recorded west African Spanish mackerel *Scomberomorus tritor* (Cuvier, 1832) and the Red Sea migrant narrow barred Spanish mackerel *Scomberomorus commerson* (Lacepsde, 1800) family: Scombridae in the Egyptian Mediterranean waters (off Abu- Qir). *Egyptian Journal of Aquatic Biology and Fisheries*, 23(1): 217-222. DOI: 10.21608/ejabf.2019.26686

Rizkalla, S.I.; Akel, E.H.Kh. and Ragheb, E.A. (2016). Biodiversity and fisheries of the non-target catch from bottom trawl, off Alexandria, Mediterranean Sea, Egypt. *Regional Studies in Marine Science*, 3: 194–204. DOI: 10.1016/j.rsma.2015.10.004

SCA 2015. New Suez Canal. SuezCanalgov.eg/English/about/Suez canal//pages/ NewSuezCanal.aspx.

Stamouli, C.; Akel, E.; Azzurro, E. and Bakiu, R., *et al.* (2018). New Mediterranean Biodiversity Records (December 2017). *Mediterranean Marine Science*, 18(3): 534-556. DOI: 10.12681/mms.15823

Streftaris, N. and Zenetos, A. (2006). Alien Marine Species in the Mediterranean - the 100 'Worst Invasives' and their Impact. *Mediterranean Marine Science*, 7(1): 87-118. DOI: 10.12681/mms.180

Zenetos, A. (2017). Progress in Mediterranean bioinvasions two years after the Suez Canal enlargement. *Acta Adriatica*, 58(2): 345-354. https://doi.org/10.32582/aa.58.2.13