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Fisheries status of Octopus (Cephalopoda: Octopodidae) in the Gulf of Suez, Egypt

Ayman S. Ahmed [1,*], Azza A. El Ganainy [1], Mohamed F. Osman [3], Magdy T. Khalil [2]

1. National Institute of Oceanography and Fisheries.
2. Faculty of Science - Ain Shams University.
3. Faculty of Agriculture - Ain Shams University.

*Corresponding Author: aahmed.niof@yahoo.com

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ABSTRACT

During the last years, the price of Octopuses in the national and international markets increased spectacularly. Due to the high demand and the attractive selling price of Octopus, most fishermen increased the fishing efforts exerted on Octopus. This study throws light on the fisheries status and species composition of Octopuses in the Gulf of Suez. A number of 2759 individuals were collected by trawling vessels from September 2017 to April 2018, and the fishing effort represented by the number of landings.

The present results showed that the trawling fishing effort fluctuated greatly from season to another between a minimum value of 1118 landings during the fishing season 2012/2013 and a maximum value of 1852 landings during 2019/2020 with an average value of 1592 landings throughout the last eight years. The species composition of Octopus caught from the Gulf of Suez comprised four species; *Amphioctopus aegina*, *Amphioctopus membranaceus*, *Octopus cyanea* and *Macrotritopus defilippi*. *A. aegina* and *A. membranaceus* were by far the most abundant among Octopus catch in the Gulf of Suez, constituting more than 91% of the catch. This information would help in the Gulf of Suez management purpose to maintain the stock of this valuable resource.

INTRODUCTION

The Gulf of Suez **(Fig. 1)** is considered as one of the major sources of fish production in the Egyptian sector of the Red Sea. Its importance as a fish resource can be attributed to the shallowness and sandy bottom which make it suitable for trawling. It is characterized by the presence of a great diversity of highly economic fish and invertebrate species **(Sanders and Morgan, 1989)**. The increasing exploitation of finfish resources and the depletion of some of major fish stocks that formerly supported industrial-scale fisheries, forces continued attention to the once-called 'unconventional marine resources', which include numerous species of cephalopods **(Jereb and Roper, 2010)**. Over the past two decades, several cephalopod species have become important for the worldwide fisheries, as targets of small scale coastal fisheries and/or as bycatch in

multispecies fisheries for demersal fish. Cephalopod catches have increased steadily in the last 45 years, from about 1 million metric tons in 1970 to more than 4 million metric tons in 2016 **(FAO, 2018)**. The total reported global production of Octopuses over the past three decades indicates a relatively steady increase in catch, almost doubling from 179,042 tons in 1980 to 355,239 tons in 2014 **(Sauer *et al.*, 2019)**.

Octopuses are relatively abundant in the trawl landings of the Gulf of Suez; they have been discarded species till 1990's **(El Ganainy *et al.*, 2005)**, but currently they have a relatively high occurrence and commercial importance in the trawl landings, representing about 0.07% of the total trawl catch **(GAFRD, 2018)**. In recent decades increasing market demands all over the world and very efficient fishing techniques, have put strong pressure on some of the most important cephalopod stocks. These stocks showed wide annual fluctuations due to many different reasons, some of which are still poorly understood **(Krstulovic *et al.*, 2005)**.

Octopus (Octopus spp) is a mollusk animal from the Cephalopod class which has a strong export market share and market demand tends to increase every year. The price of raw Octopus material in the international market increased spectacularly from $ 4 to $ 12. This means that prices have increased by 200% over this decade, while for processed products the price of per kilogram reaches $ 40 to $ 50 **(Kolkovski *et al.*, 2015)**.

Biological information on Octopuses in the Gulf of Suez is very scarce; only **(Riad and Gabr, 2007)** studied some morphometric relationships and natural mortality of *O. vulgaris*, **(Riad, 2008)** studied the morphology and taxonomy of some cephalopods. **(El Ganainy and Riad, 2008)** studied the population structure of *Octopus defilippi* and **(Osman, 2013)** studied the biological and morphological aspects of *O. aegina*. Therefore, this study throws light on the fishery status and species composition of Octopus species, where the final output should improve the state of the current production and fishery management of Octopus species in the Gulf of Suez.

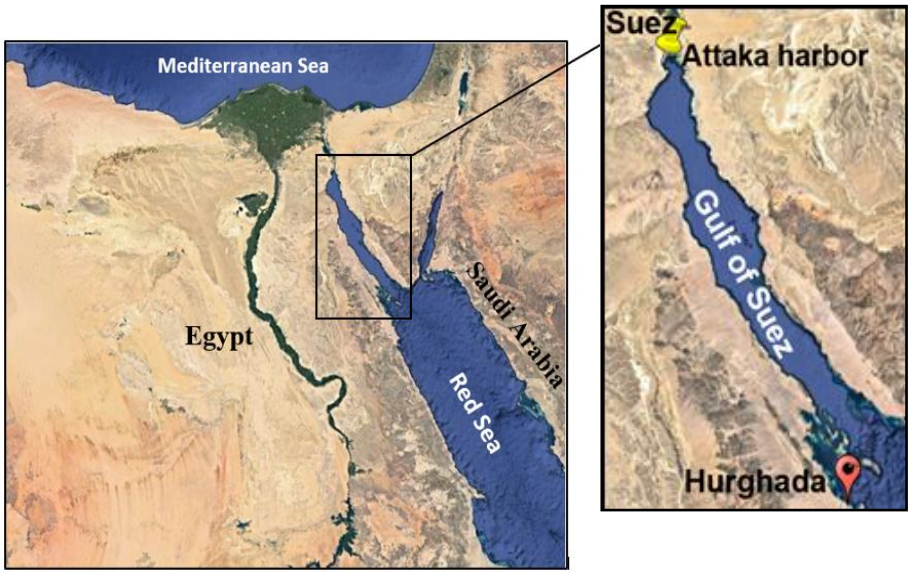

Fig. 1. A map of Gulf of Suez showing Attaka fishing harbor.

MATERIALS AND METHODS

Data concerning the Octopus catch and annual total trawl catch as well as annual trawling fishing effort expressed as the number of landing during the fishing seasons from 2012/2013 to 2019/2020 were obtained from the fisheries office of the General Authority for Fish Resources Development (GAFRD) at Suez province. These data were used to evaluate the catch per unit effort, (as an index of relative abundance) which was calculated by dividing the annual Octopus catch and annual total trawl catch by the annual fishing effort in terms of number of landings.

The fishery is seasonal (September through mid of April or beginning of May) in all the landing sites of the Suez Gulf. Monthly sampling was carried out in the period of study during the fishing season from September 2017 to April 2018. In total, 2759 specimens of different Octopus species were collected from the commercial landings by trawler vessels that landed in Attaka fishing harbor **(Fig. 1)**.

After samples collection, they were investigated in the Fisheries Biology Laboratory of the National Institute of Oceanography and Fisheries (NIOF), Suez Branch, for species identification by using the FAO species catalogue for fishery purposes **(Jereb *et al.*, 2016)**.

The mantle length (ML) data obtained were grouped into mantle length classes at 0.5 cm intervals and subsequently the frequency of each class was determined.

RESULTS

Catch statistics

The annual total trawl catch and Octopus catch (ton) landed at Attaka harbor in the Gulf of Suez during the last eight years from the fishing season 2012/2013 to 2019/2020 were graphically represented in **Figure (2)**. It is clear that, the total trawl catch fluctuated between a maximum value of 4705.97 tons recorded during the fishing season 2019/2020 and a minimum value of 2459.58 tons recorded during 2013/2014 with a mean value of 3720.47 tons throughout the eight years. On the other hand, the annual Octopus catch fluctuated between a maximum value of 32.9 tons in 2019/2020 and a minimum value of 19.32 tons in 2017/2018. The values represented 0.70% and 0.59% of the total trawl catch, respectively. The average Octopus catch was 24.32 tons represented 0.65% of the total trawl catch, throughout the eight years **(Fig. 2)**.

The monthly total trawl catch and Octopus catch (ton) during the fishing season 2017/2018 (the period of study) were graphically represented in **Figure (3)**. It is clear that, the total trawl catch fluctuated between a maximum value of 858.32 tons recorded in October 2017 and a minimum value of 90.2 tons recorded in April 2018 with a mean value of 409.28 tons throughout the eight months. Also, the monthly Octopus catch fluctuated between a maximum value of 4.56 tons in March 2018 and a minimum value

of 0.24 ton in September 2017. The values represented 1.82% and 0.08% of the total trawl catch, respectively. The Octopus catch shows a trend of increase from the beginning of the fishing season (Sep.) until the end of the season in mid-April. The average Octopus catch was 2.41 tons represented 0.59% of the total trawl catch, throughout the eight months.

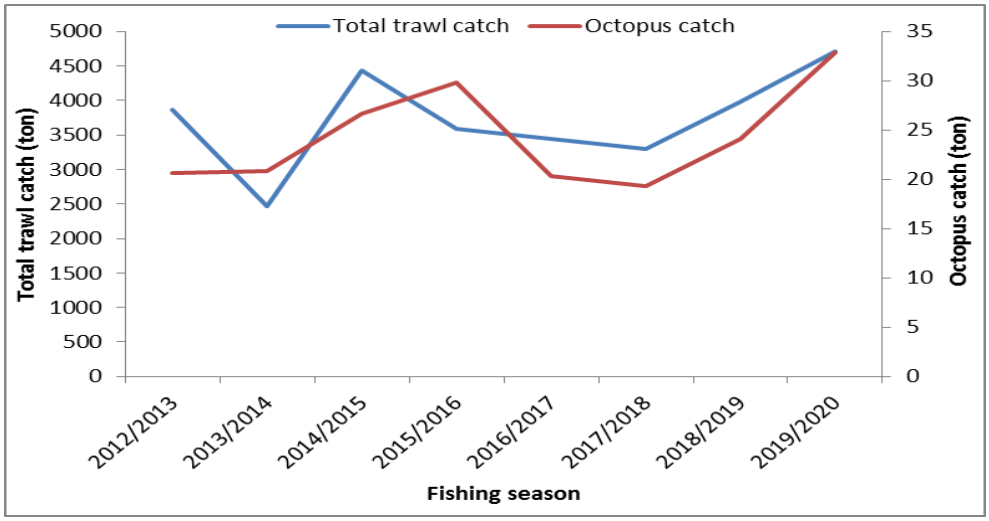

Fig. 2. Annual total trawl and Octopus catch (ton) in the Gulf of Suez from the fishing season 2012/2013 to 2019/2020.

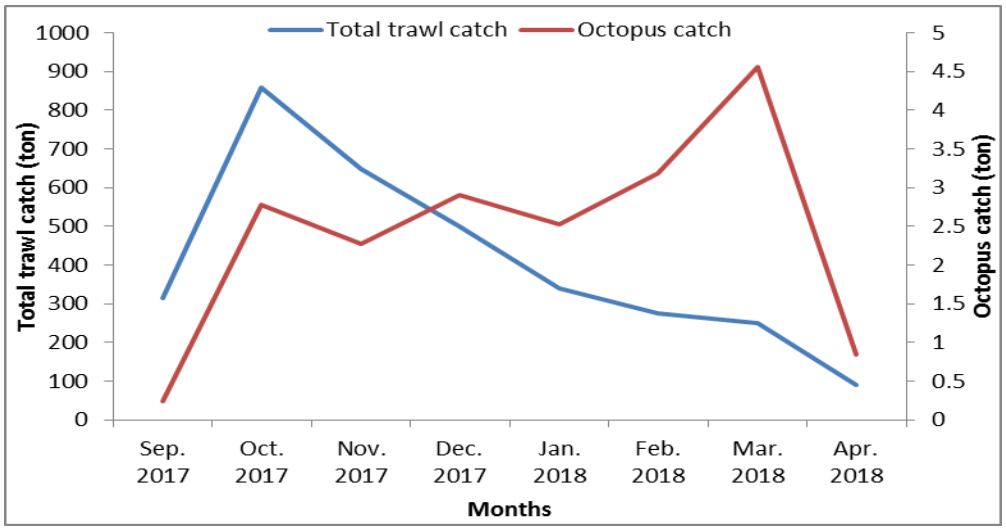

Fig. 3. Monthly total trawl and Octopus catch (ton) in the Gulf of Suez during the fishing season 2017/2018.

Fishing effort and catch per unit fishing effort (CPUE)

The annual fishing effort of the trawlers operating in the Gulf of Suez represented by the number of landings during the last eight fishing seasons 2012/2013 - 2019/2020 was graphically represented in **Figure (4)**. It was obvious that the exerted fishing effort fluctuated greatly from season to another between a minimum value of 1118 landings during the fishing season 2012/2013 and a maximum value of 1852 landings during 2019/2020 with an average value of 1592 landings throughout the eight years. The calculated annual catch per unit of fishing effort represented by ton per landing for the total trawl catch during the last eight fishing seasons (2012/2013–2019/2020) was represented graphically in **Figure (5)**. In respect to the total trawl catch per landing, there was a noticed variation in the values from fishing season to another. The highest value was recorded during the fishing season 2012/2013 (3.457 ton/landing) and the lowest value was recorded during the fishing season 2013/2014 (1.532 ton/landing) with an average value of 2.337 ton/landing throughout the last eight fishing seasons.

On the other hand, the calculated annual catch per unit fishing effort represented by ton per landing for the Octopus catch during the last eight fishing seasons (2012/2013–2019/2020) was represented graphically in **Figure (6)**. The Octopus catch per landing fluctuates between (0.01 ton/landing) and (0.02 ton/landing) with an average value of 0.02 ton/landing throughout the last eight fishing seasons **(Fig. 7)**.

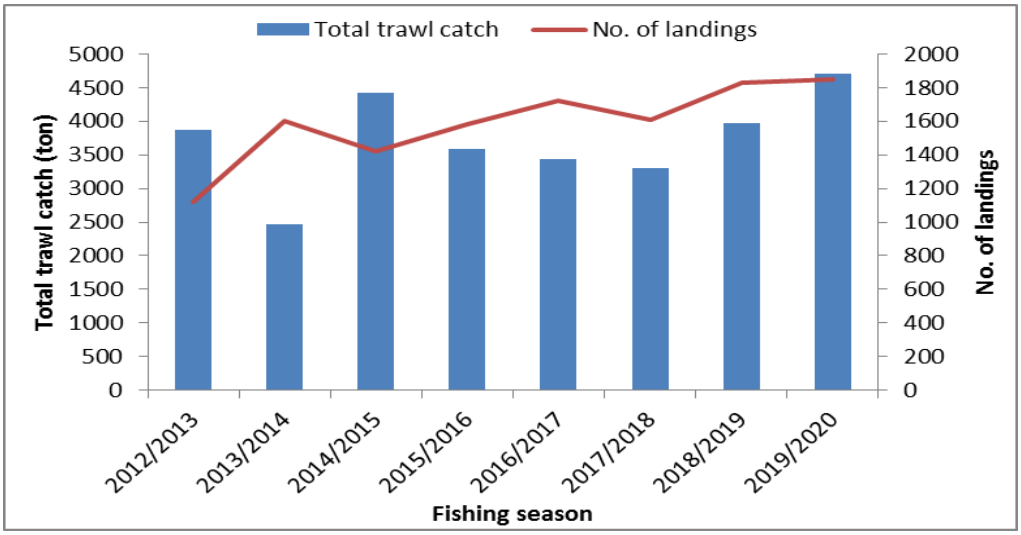

Fig. 4. Total trawl catch and effort (number of landings) in the Gulf of Suez from the fishing season 2012/2013 to 2019/2020.

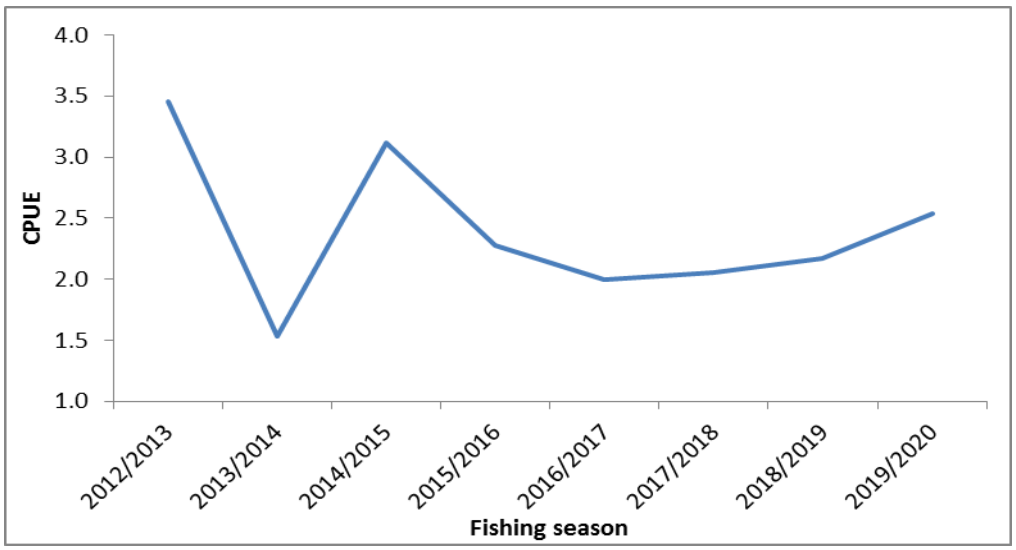

Fig. 5. Catch per unit effort for total trawl fishery in the Gulf of Suez from the fishing season 2012/2013 to 2019/2020.

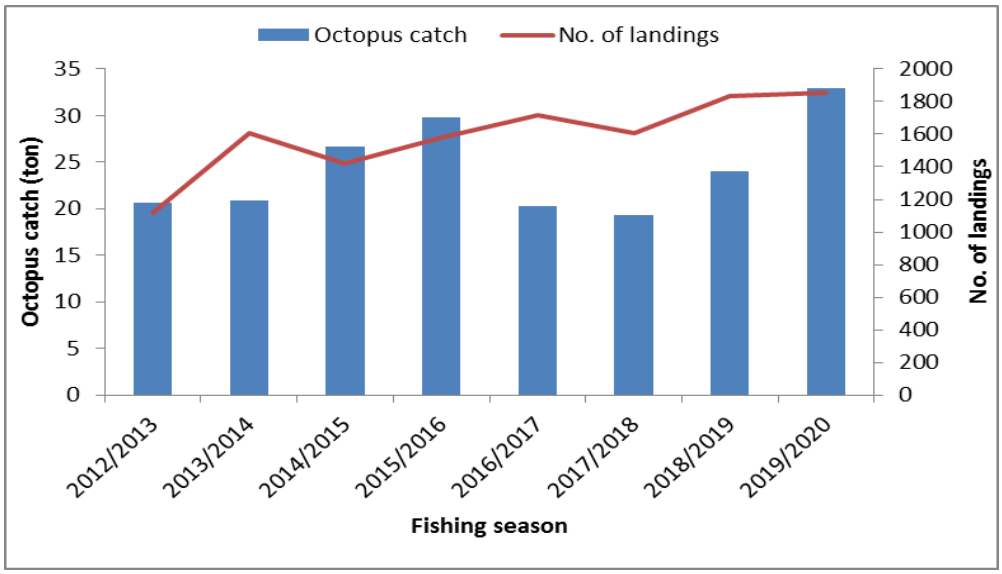

Fig. 6. Octopus catch and fishing effort from the Gulf of Suez during the fishing seasons from 2012/2013 to 2019/2020.

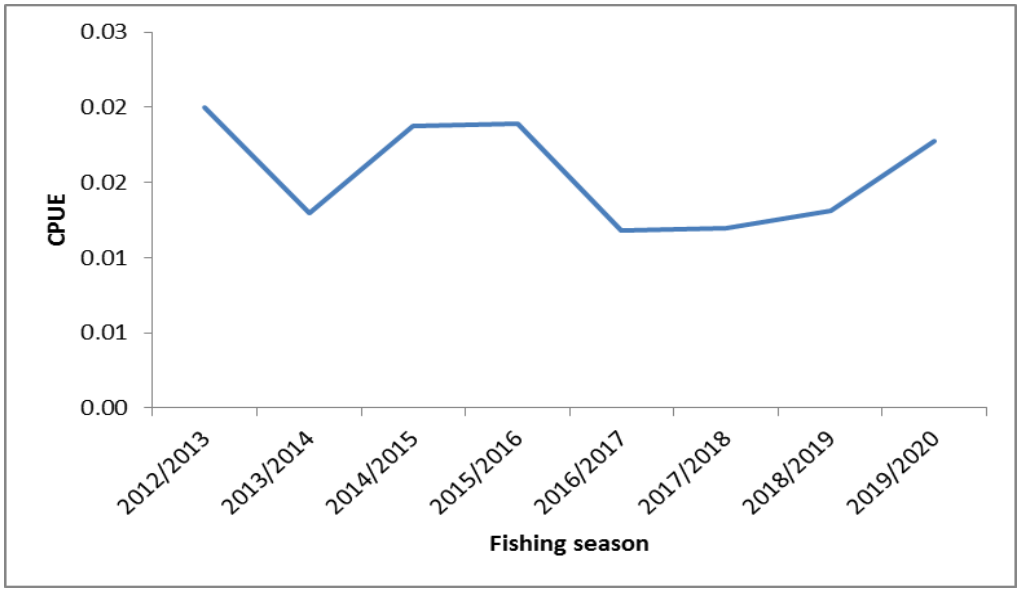

Fig. 7. Catch per unit effort for Octopus caught by trawling in the Gulf of Suez from the fishing season 2012/2013 to 2019/2020.

Species composition

The species composition of Octopus caught from the Gulf of Suez comprises four species; *Amphioctopus aegina* (Gray, 1849), *Amphioctopus membranaceus* (Quoy and Gaimard, 1832), *Octopus cyanea* (Gray, 1849) and *Macrotritopus defilippi* (Verany, 1851), **(Fig. 8)**. *A. aegina* and *A. membranaceus* were by far the most abundant among Octopus catch in the Gulf of Suez, constituting more than 91% of the catch by weight and about 95% of the catch by number, where the other two species were the least abundant of Octopus they appear occasionally in the catch **(Figures 9 & 10)**.

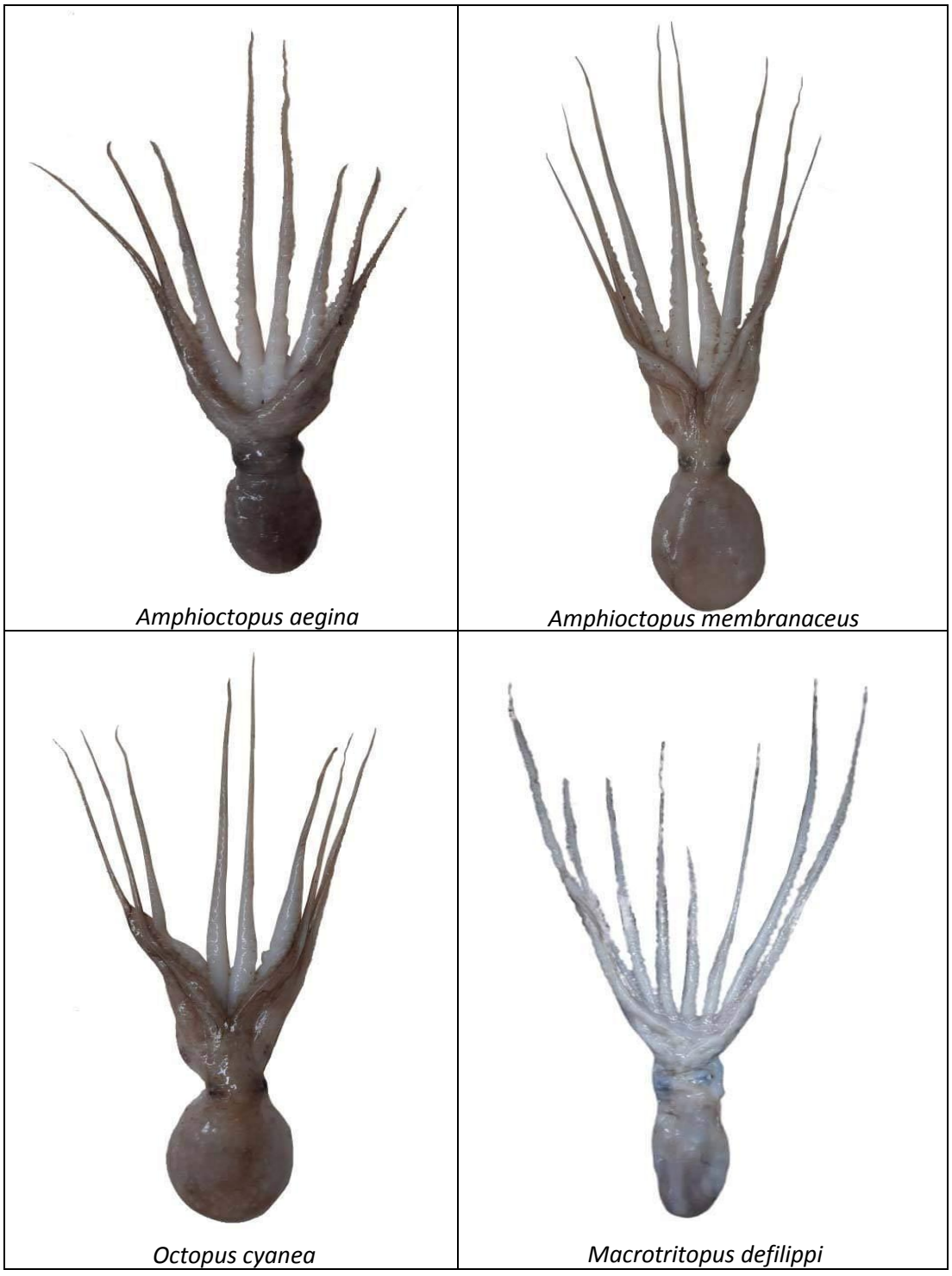

Fig. 8. Octopus species recorded from the Gulf of Suez trawling catch during the period of study (from Sep. 2017 to Apr. 2018).

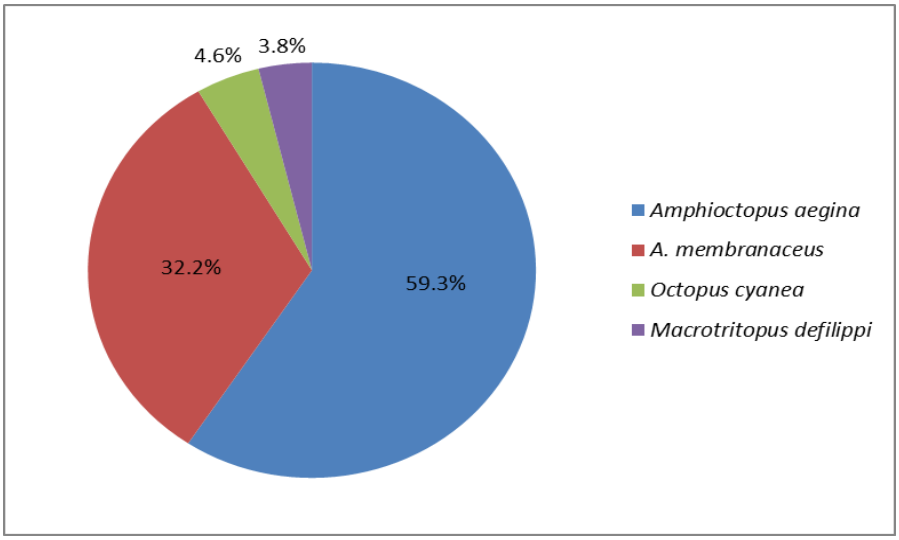

Fig. 9. Species composition (Wt) of the Octopus population from the Gulf of Suez during the period of sampling.

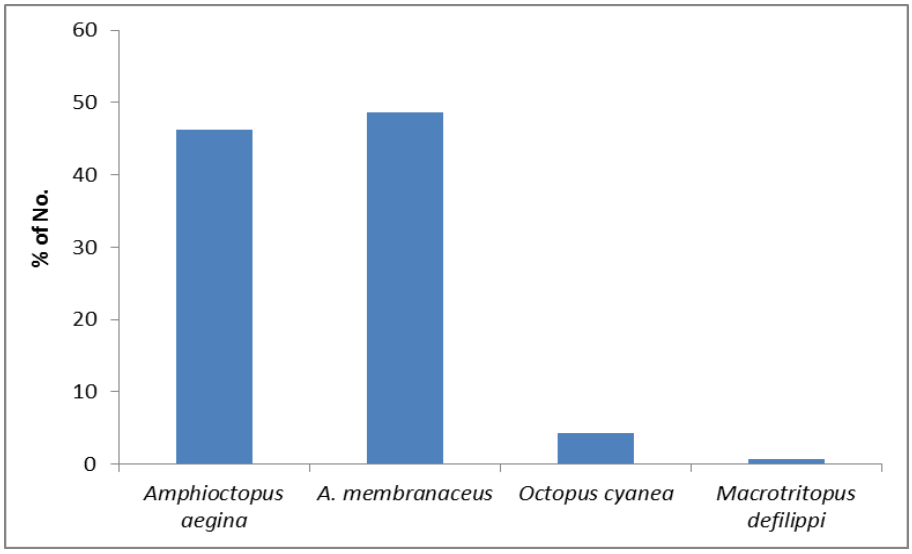

Fig. 10. Species composition (No.) of the Octopus population from the Gulf of Suez during the period of sampling.

Length-frequency distribution

The length-frequency distribution of 833 individuals of *A. aegina* (450) and *A. membranaceus* (383) that were collected from the Gulf of Suez in the period from September 2017 to April 2018 was graphically represented in **Figures (11 & 12)**. The data indicated that the mean mantle length (ML) of *A. aegina* was 5.74 cm with a minimum value of 1.9 cm and a maximum value of 9.9 cm, and the main bulk of individuals about 83.11% were represented in class intervals from 4.2 to 7.2 cm for both

males and females. Also, the mean ML of *A. membranaceus* was 4.65 cm with a minimum value of 2.4 cm and a maximum value of 8.6 cm, and the main bulk of individuals about 81.46% were represented in class intervals from 3.2 to 5.7 cm for both males and females.

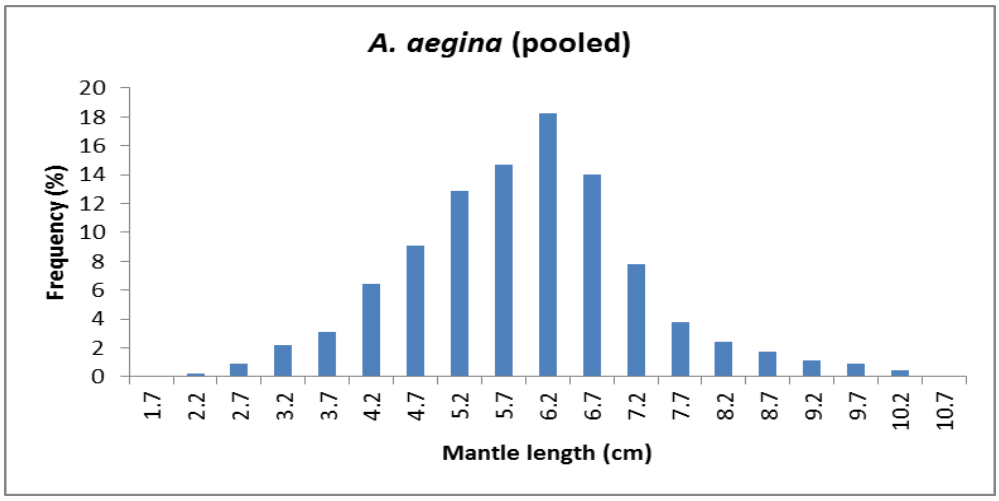

Fig. 11. Length-frequency distribution of *A. aegina* collected from the Gulf of Suez during the fishing season 2017/2018.

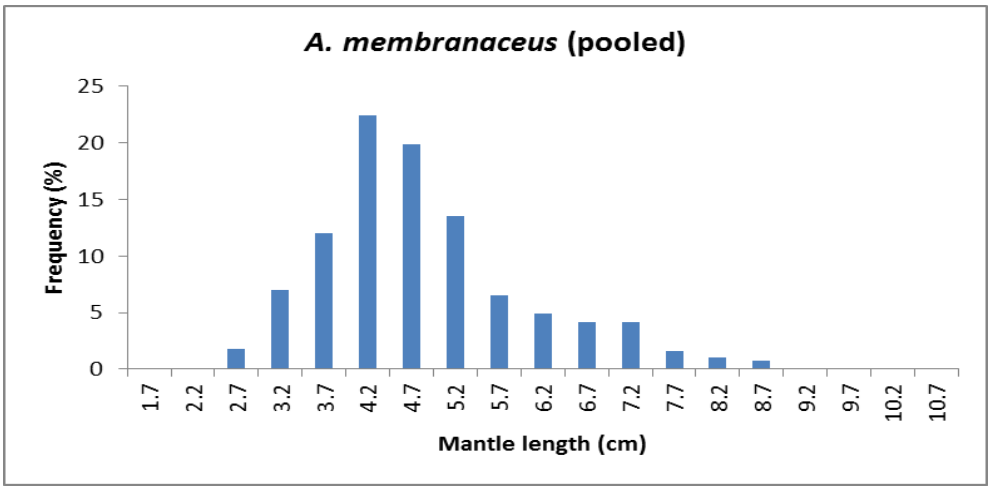

Fig. 12. Length-frequency distribution of *A. membranaceus* collected from the Gulf of Suez during the fishing season 2017/2018.

DISCUSSION

The trawls catches are not selective, since the most common commercial trawl species in the Gulf of Suez comprises many finfish and invertebrate species. Attaka fishing harbor considered the main fishing port along the Gulf of Suez where about (61.24%) of the total landings comes from it, followed by EI-Tour (25.44%) and there are

small other landing sites e.g. Salkhana (8.46%) and Ras Gharib (4.85%), **(GAFRD, 2018)**. The Octopus is a mollusk animal from the cephalopod class and it is one of products of Gulf of Suez which has market demand tends to increase every year, where the price of Octopus in the European markets reached to 47.25 €/kg in 2020 (personal communication).

Statistical analysis concerning the catch, effort and catch per unit effort are of great importance for the evaluation of the status of the exploited fish stocks **(Sanders *et al.*, 1984)**. There were no studies carried out on catch and catch per unit effort of Octopus species in the Gulf of Suez. While, **Carreira and Goncalves (2009)** studied the catch per unit effort (CPUE) for *O. vulgaris* in the Azores of the Atlantic. An average catch per unit of effort (CPUE) of 0.22 Octopuses/trap/hour*100 was attained, and the highest mean value was reached at the shallowest depths (28 m), with 0.33 Octopuses/trap/hour*100. A decreasing CPUE with depth was observed, in accordance with what has been found for this species elsewhere. In the present study, the analysis of annual catch records showed that the production of Octopus fluctuated between 19.32 - 32.9 tons throughout the last eight fishing seasons. Also, the production of Octopus increased gradually in the last three months of the fishing season 2017/2018 (period of study). This may be due to the increasing fishing effort exerted on the demersal species as well as on Octopus species in the Gulf of Suez.

Some studies in the Gulf of Suez were conducted on Octopus species **(Riad and Gabr, 2007; El Ganainy and Riad, 2008; Riad, 2008; Osman, 2013 and Osman *et al.*, 2014a,b)**. **Riad (2008)** recorded five species from the Gulf of Suez in the Red Sea, they were *Octopus vulgaris*, *O. macropus*, *O. defilippi*, *O. aegina* and *O. membranaceus*. The most abundant species is *O. aegina* which represent about 50.8% of the total catch followed by *O. macropus*, *O. membranaceus*, *O. defilippi* and *O. vulgaris*, which represent 15.9, 14.3, 11.1% and 7.9% respectively. This confirms our results that *O. aegina* and *O. membranaceus* are the most abundant Octopus species in the Gulf of Suez. Moreover, **Riad (2000)** recorded for the first time the Cephalopoda *Rossia macrsoma* and *Octopus defilippi* in the Egyptian Mediterranean waters. *Octopus aegina* form the basis of large export trawl fisheries, particularly from the Gulf of Thailand where it is treated under the junior synonym name, *Octopus dollfusi* Chotiyaputta (1993). Marketed widely around the world with other *Amphioctopus* species under the name 'baby Octopus'. Also, *Amphioctopus membranaceus* Quoy & Gaimard (1832) form the basis of high value commercial fisheries, particularly in Southeast Asia **(Jereb *et al.*, 2016)**.

It is worth noting that, in the later revision on Octopods **(Norman and Hochberg, 2005)** the genus *Octopus* was synonymized by the genus *Amphioctopus* for two species in the present study namely *Octopus aegina* and *Octopus membranaceus* they changed to *Amphyoctopus aegina* and *Amphyoctopus membranaceus*. As for *Octopus defilippi* it changed to *Macrotritopus defilippi* **(Jereb *et al.*, 2014)**.

The results of length frequency distribution were similar to that reported by **Ignatius *et al.* (2011)** they mentioned that the dominant size groups of *Octopus aegina* from Mandapam waters (Palk bay), Southeast coast of India were 5.5 - 5.9 cm for both males and females.

CONCLUSION

The results of the current study are important to fisheries management and conservation authorities as they support the contention that Octopus species may be particularly vulnerable to overfishing and their populations probably have low resilience to exploitation. So, reducing exploitation rate can be done through output control management, such as determination of total allowable catch, as well as input control management, such as reduce the fishing effort and number of fishing landings.

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