Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 24(2): 495 – 506 (2020)
www.ejabf.journals.ekb.eg

The Coastal Fisheries in Tangier port: Catch assessment and Current Status

Fahd Darasi [1,3]*, Sahar Mehanna[2] and Mustapha Aksissou[1]

1- Faculty of Sciences, Abdelmalek Essaadi University, Tetouan, Morocco
2- National Institute of Oceanography and Fisheries, Fisheries Division, Egypt
3- Marine Sciences and Biological Research Authority, Hodeidah, Yemen

*Corresponding Author: fdarasi@uae.ac.ma

ARTICLE INFO

Article History:
Received: April 13, 2020
Accepted: April 21, 2020
Online: April 23, 2020

Keywords:
CPUE
Catch
Longline
Purse-seine
Port of Tangier
Trawl
Surplus models

ABSTRACT

The region of Tangier is a typical multi-species and multi-fleet fishery with a large diversity of species exploited by a wide range of fishing techniques. The aim of this study is to evaluate the current status of coastal fishing in the port of Tangier for different coastal fishing types (trawl, purse-seine and longline), and assess the different fishing gears types operated in the port. Fishery statistics, for the different fishing types over 7 years (2011 to 2017) were collected and analyzed. The composition of fish resources in the port of Tangier is 70% pelagic fish, 24.5% demersal fish, 3.2% crustaceans, and 2.3% cephalopods. The Schaefer model was applied to the catch per unit of fishing effort (CPUE) indices to determine the level of utilization (maximum potential sustainable). The present level of fishing effort of trawl and purse seine fisheries could be expanded to obtain MSY, while for longline the catch could be increased by about 94% of its current value by applying the current number of vessels. The 2/3 f_{MSY} as a target reference point was estimated for the longline fishery, where fishing can be increased by about 72% through reducing the number of fishing vessels by 31% of its current number, but further studies using analytical models and more time series data are needed before any action.

INTRODUCTION

An assessment of the state of marine fishery resources, maximum fleet size and potential fishing effort to exploit resources on a sustainable level is essential for adequate planning, development of the marine fisheries sector **(Sathianandan et al., 2008)**. Changes in fisheries productivity provides data on the level of fish catch and fishing effort to assess fishing competitiveness **(Islam et al., 2011)**. These changes in the productivity of various fishing gear require changing regulations and policies to improve efficiency without a corresponding increase in inputs used **(Tai and Hussein, 1997)**. Measuring productivity can provide useful information regarding the effective fishing effort, rather than nominal voltage measures **(Squires, 1994)**.

Sustainable fisheries imply that the number or weight of a fish species that can be harvested from its stock biomass shouldn't be above the maximum sustainable yield (MSY) **(Hilborn and Walters, 1992)**. Schaefer and Fox surplus production models are frequently applied to calculate the MSY for fisheries **(Prager, 1994)**. These models are much popular **(Quinn and Deriso, 1999)** for stock assessment of tropical fisheries since main inputs for these models are catch and effort data.

The Moroccan fishing fleet consists of 449 deep sea fishing units with a total capacity of 144812 gross tonnage GRT and 2544 coastal fishing vessels with 114985 GRT and 15428 artisanal vessels. The marine fisheries sector employs 65,000 fishermen active in coastal and deep-sea fisheries and around 74,000 active sailors in artisanal fisheries. The recent evolution of fishery sector in Morocco has been marked by three main sceneries: 1) 1980's witnessed the opening of some ports which gave a new breath to the fisheries, 2) 1990's repatriation of national high seas fleet and 3) the withdrawal of the European fleet from the national waters **(Atmani, 2003)**. The coastal fishing fleet consists of 2544 units corresponding to a total capacity of 114985 GRT. It is divided into seiners, trawlers and longliners ranging from 15 to 25 m length, and built locally in wood **(Boudinar, 2007)**. The region of Tangier is a typical multi-species multi-fleet fishery with a large diversity of species exploited by a wide range of fishing gears. The coastal fleet operating in the port of Tangier consists of about 206 vessels, ranging from 15 to 24 m **(ONP, 2017)**.

The catches of coastal trawlers in the North Atlantic zone, extending between Tangier and Boujdour, are larger compared to the Mediterranean. They are composed of a greater number of species: 140 in total, of which 20 provide 86% of the total catch **(INRH, 2017)**.

The increasing of fish harvesting in the region of Tangier is feared that will lead to overfishing or decreasing the number of catches. One step that should be done, is to carry out stock assessments to determine the optimum efforts and utilization level of fish resources required for sustainable harvesting. The study of the sustainable potential and the level of utilization of fishery resources is extremely important to control and monitor the level of fishing exploitation of these fishery resources **(Wiyono *et al*., 2018)**.

Although problems may be identified, they cannot be supported by any analysis due to insufficient data, as there have been no estimates of the total allowable catch and no analysis of the reasonable fishing effort level in different fishing areas and species. Thus, stakeholders in the local authority have no sound basis for designing and implementing appropriate management measures, even if previous reports contain few proposals for improving policy, planning or management of this valuable resources **(Van Phuong, 2016)**.

The present study was done to evaluate and update the data concerning catch, effort and catch per unit fishing effort, estimation of the maximum sustainable yield (MSY) and the optimal level of fishing effort (f_{MSY}) for purse seines, trawls and longlines. This information will be useful for the sustainable management of coastal fisheries in the port of Tangier, Morocco.

MATERIALS AND METHODS

Study area

The Port of Tangier is located at the North-western end of Morocco, on the southern shore of the Strait of Gibraltar, at 35° 47.3' N 5° 48.3' W (Fig. 1). The latter constitutes the connection between the Mediterranean and the Atlantic Ocean, its length varies respectively from 14 to 15 km between Cape Spartel and Cape Trafalgar to the west and between the point of Europe and the point of Almina to the east, the depth varies between 80 and 1200 m **(Benhardouze, 2009)**.

Fig. 1. A map of the study area (Tangier-Morocco)

Data collection

Fishing effort data were obtained from the National Office of Fisheries (ONP), which represents the number of landings, the number of fishing boats and the total annual catch and catch by species during the period 2011 to 2017. Whereas data on the characteristics, type and size of coastal fishing equipment and the number of fishing days were obtained from the maritime fisheries delegation (DPM) in Tangier.

Methods

The maximum sustainable yield (MSY) and the optimum fishing effort (f_{opt}) as biological reference points, for the three fisheries in the port Tangier, were estimated using the logistic production model of Schaefer **(1954&1957)** as incorporated in ASPIC 5 computer program of **Prager (2004)**. The essential equation used in MSY and CPUE at f_{opt} ($CPUE_{opt}$) estimation was as follows:

$dB/dt = rB - r/K * B2 - q B E$

Then $dB/dt = rB - r/K * Bm - C$

Where B is the biomass of the stock, E is the fishing effort, C is the catch rate, K is the carrying capacity of the habitat where the stock lives, r is the intrinsic rate of growth of the stock and q is the catchability coefficient.

RESULTS AND DISCUSSION

The number of active fishing fleets in the port of Tangier during the years from 2011 to 2017 is shown in (Fig. 2). The Tangier coastal fleet is mainly longline and represents the highest of all years. Generally, the number of trawlers fluctuated from year to year showing an increasing trend during the study period, while the longliners showed a decreasing trend but a steady trend was noticed for the purse seiners.

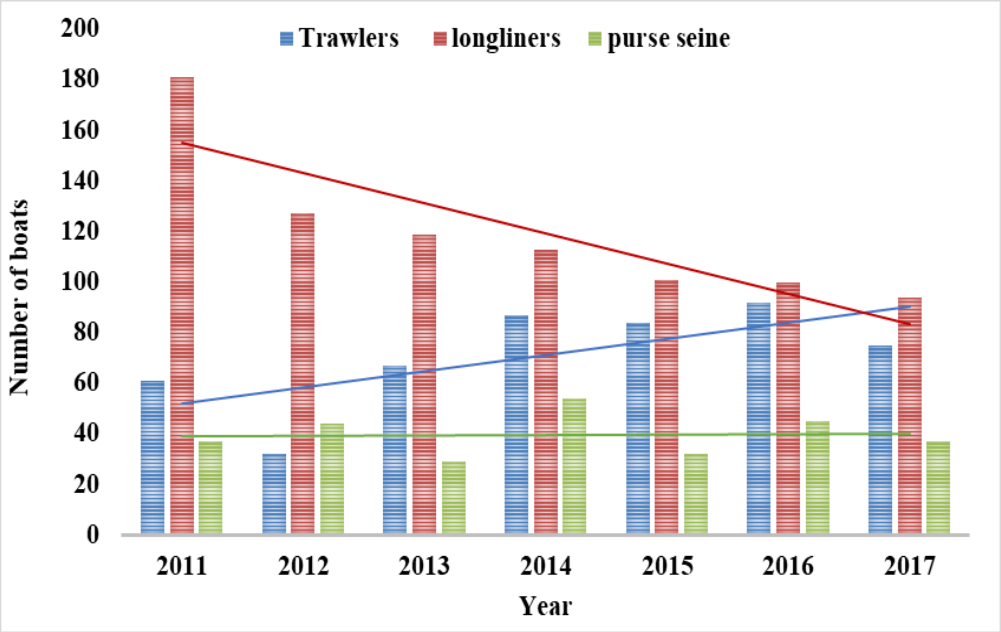

Fig. 2. Evolution of the number of coastal fishing boats in the port of Tangier from 2011-2017

Catch statistics

The annual total catch of the three fishing methods at port Tangier during the period from 2011 to 2017 was represented graphically in (Fig. 3). The total catch of the trawl fishery varied from a minimum of 870 ton (2011) to a maximum of 5686 ton (2015) with a mean of 2385.5±1700.9 ton, the increase in production in 2015 is due to an increase in the number of trips **(Darasi and Aksissou, 2019)**. While the total catch of the purse-seine fishery fluctuated from a minimum value of 2255 ton (2017) to a maximum of 4478 ton (2014) with a mean of 3112.97±877.5 ton. On the other hand, longline catch varied between a minimum of 528 ton during 2017 and a maximum of 1086 ton during 2015 with a mean of 866.29±209.0 ton. It is also due to the use of fishing technology and fishing practices such as fishing gear and fishing distance **(Daurès et al., 2009)**.

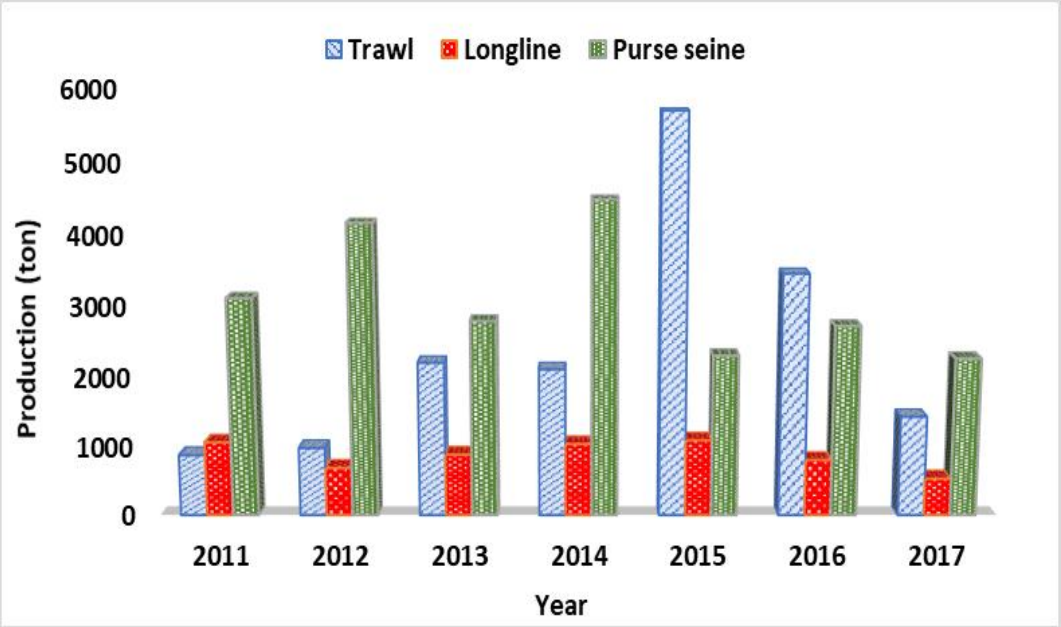

Fig. 3. The coastal fish production by type of fishing gear (tons) at Tangier port from 2011 to 2017

Catch composition

Based on data obtained from the National Office of Fisheries for the period 2011-2017, the catch was composed of four groups; pelagic fishes which include the large and small surface fishes, benthic fishes, crustaceans and molluscs (Fig. 4). Pelagic fishes were the largest group represented in the catch forming about 70% of the total catch landed in the port followed by the demersal fishes which constitute 24.5%, then crustaceans of 3.2% and cephalopods of 2.3%.

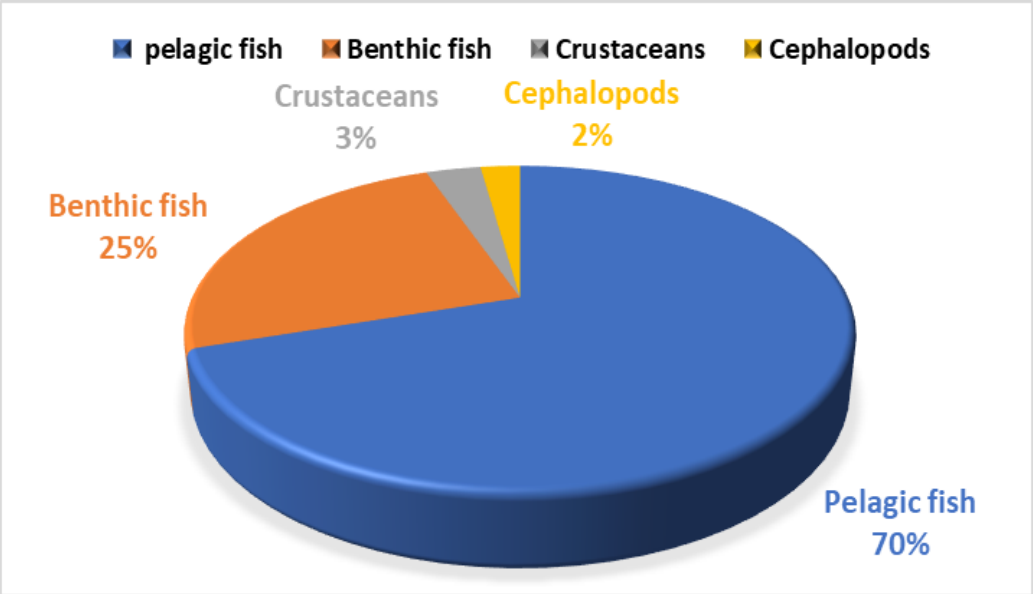

Fig. 4. Catch composition by fish groups from port of Tangier

Pelagic fishes

The pelagic fish populations consisted of more than 20 species. The most dominant families are Carangidae (*Trachurus trachurus, T. picturatus, T. mediterraneus, Trachinotus ovatus* and *Campogramma glaycos)*, Scombridae (*Auxis thazard thazard, Euthynnus alletteratus, Katsuwonus pelamis, Scomber scombrus, Thunnus alalunga, T. thynnus*, and *T. albacares*), Clupeidae (*Sardina pilchardus, Sardinella maderensis*, and *S. aurita*) Engraulidae (*Engraulis encrasicolus*), Xiphiidae (*Xiphias gladius*) (Fig. 5).

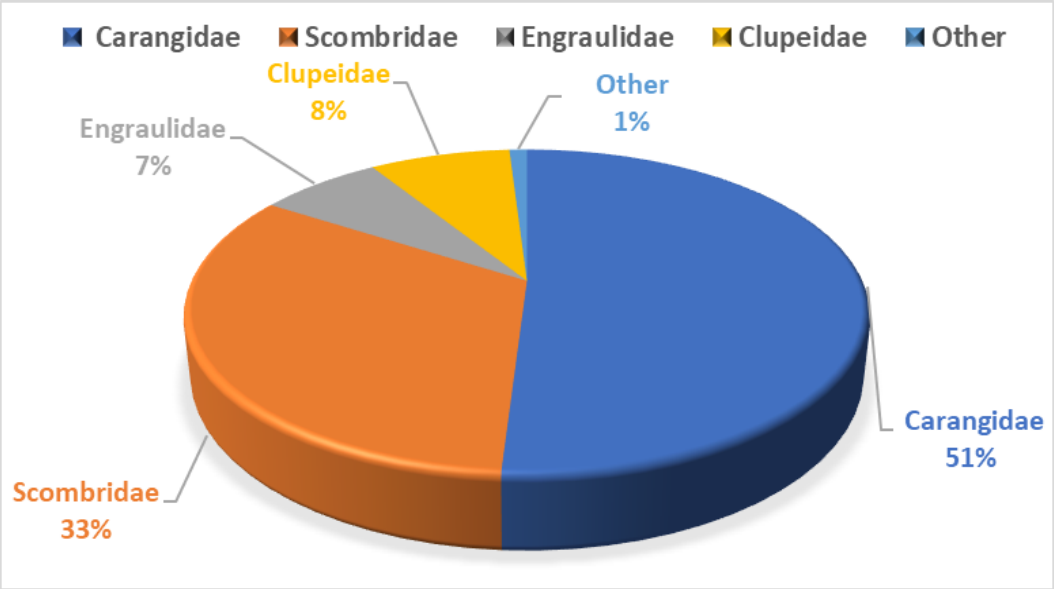

Fig. 5. Composition of dominant pelagic fishes

Benthic fishes

The benthic fish populations consisted of 60 species in the port of Tangier. The dominant benthic fish families were Sparidae (*Boops boops, Dentex dentex, Diplodus cervinus, D. vulgaris, D. annularis, D. sargus, D. puntazo, Lithognathus mormyrus, Oblada melanura, Pagellus acarne, P. bogaraveo, P. erythrinus, Sarpa salpa, Pagrus pagrus, Sparus aurata* and *Spondyliosoma cantharus*), Sciaenidae (*Argyrosomus regius, Sciaena umbra, Umbrina canariensis, U. cirrosa* and *U. ronchus*), Mullidae (*Mullus surmuletus* and *M. barbatus*), Merluccidae (*Merluccius merluccius*), Gadidae (*Merlangius merlangus, Micromesistius poutassou, Trisopterus luscus* and *T. luscus*), Anguillidae (*Anguilla anguilla*), Congridae (*Conger conger*), Citharidae (*Citharus linguatula*), Argentinidae (*Argentina sphyraena*), Centracanthidae (*Centracanthus cirrus*), Triglidae (*Spicara flexuosa* and *S. maeno*), Coryphaenidae (*Coryphaena hippurus*), Haemulidae (*Plectorhinchus mediterraneus* and *Pomadasys incisus*), Soleidae (*Dicologlossa cuneata, Microchirus variegatus, Pegusa lascaris, Solea senegalensis* and *Solea solea*), Lophiidae (*Lophius budegassa* and *L. piscatorus*), Zeidae (*Zeus faber*), Scyliorhinidae (*Scyliorhinus canicula* and *S. stellaris*), Triakidae (*Galeorhinus galeus, Mustelus asterias, M. mustelus* and *Galeorhinus galeus*), Centrophoridae (*Centrophorus granulosus*), Squalidae (*Squalus acanthias*), Dasyatidae (*Dasyatis pastinaca*), Rajidae

(*Raja miraletus*, *R. asterias* and *R. polystigma*) (Fig. 6). Besides, the Crustaceans that landed at the port of Tangier consist of 6 species (Fig. 7). The dominant crustaceans were the family Penaeidae (67%), followed by a family Squillidae (20%), and family Aristeidae (13%). The group of molluscs consists of 7 species (Fig. 8) and the dominant families were Octopotidae (45%), Loligindae (30%), Sepiidae (17%), and Ommastrephidae (8%).

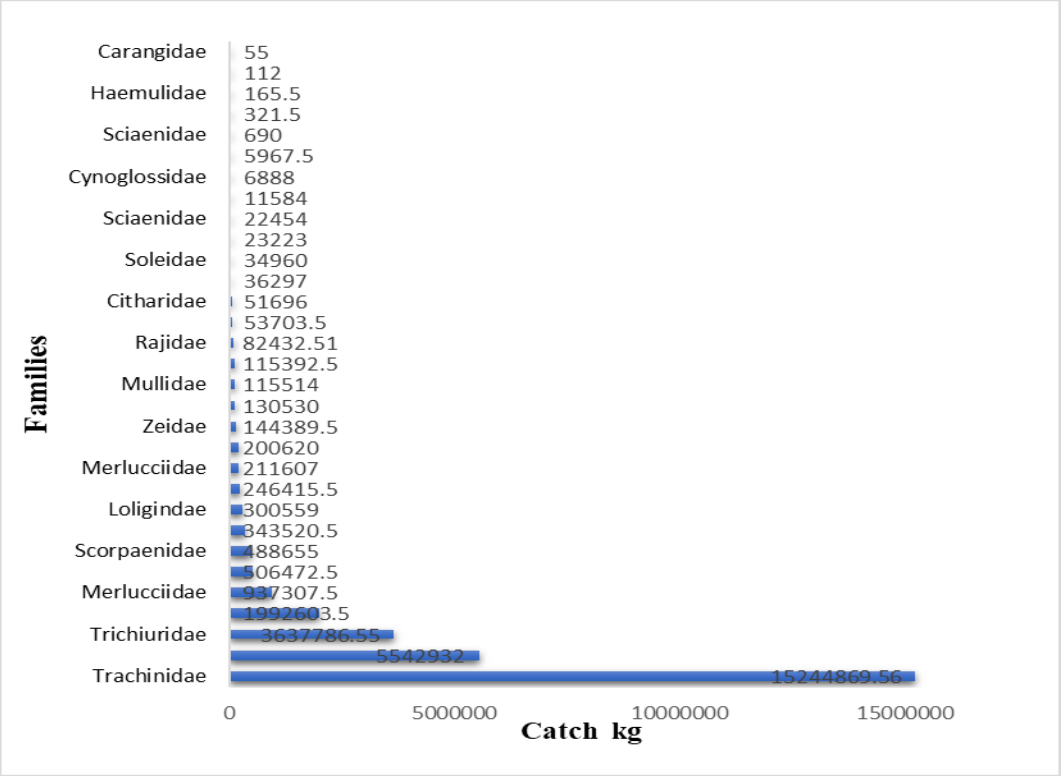

Fig. 6. Composition of dominant benthic fish

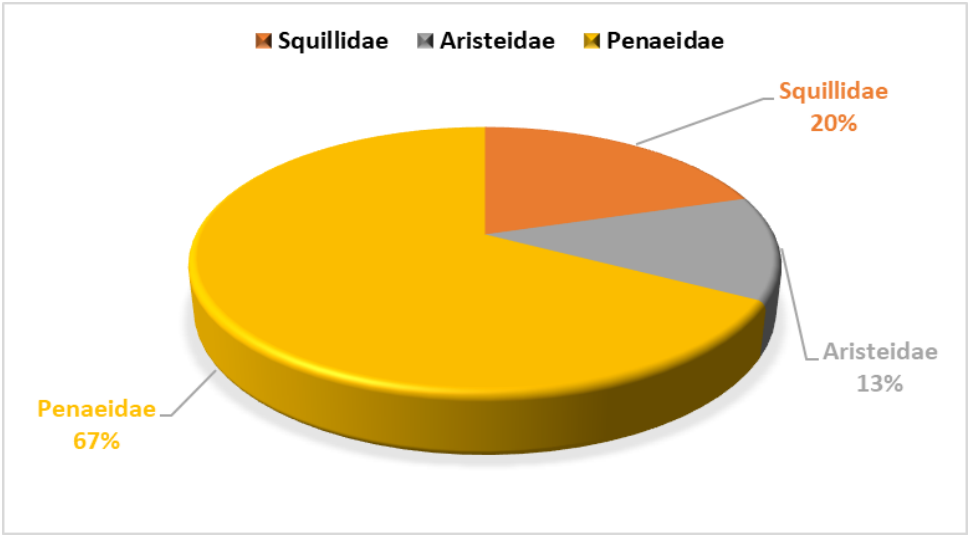

Fig. 7. Composition of the dominant Crustacean families

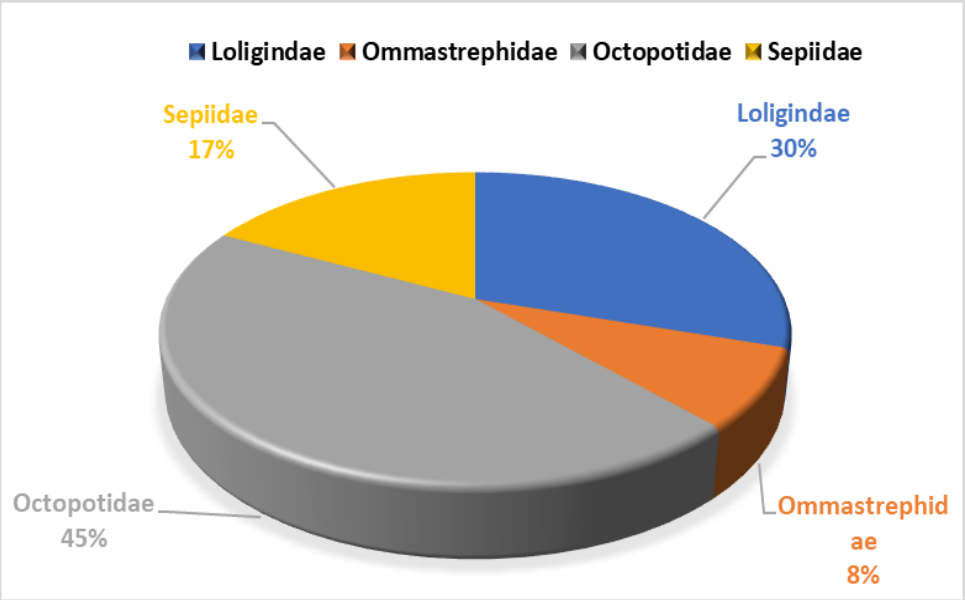

Fig. 8. Composition of the dominant cephalopod families

Catch Per Unit of Fishing Effort (CPUE)

The catch per unit fishing effort (CPUE) gives the first sight about the relative abundance of the different fish stocks and consequently the status of the fishery. The total trawl catch per unit of fishing effort ranged between a minimum of 17.4 ton/vessel during the 2017 and a maximum of 51.0 ton/vessel during 2015 with a mean of 35.16±11.68 ton/vessel. The catch per unit fishing effort of purse-seine varied from a minimum of 60.33 ton/vessel during 2013 to a maximum of 96.03 ton/vessel during 2014 with a mean of 78.62±14.69 ton/vessel. The values of total longline catch per unit of fishing effort varied between a minimum of 5.4 ton/vessel during 2012 and a maximum of 10.76 ton/vessel during 2015 with a mean of 7.44±2.01 ton/vessel (Fig. 9). Generally, there is a decreasing trend in CPUE for the three fishing methods and the longline fishery was the most impacted fishery by the existing fishing effort showing a decreasing trend in the relative abundance of different stocks exploited by it.

Surplus Production Models

Scientific advice on fisheries management is generally based on the results of the application of some form of stock assessment technique **(Hilborn and Walters, 1992)**. The surplus production models had been developed to determine the equilibrium or sustainable yield that may be harvested from a fishery for a given level of effort. They provide a first assumption about the fishery and detect the preliminary status of it **(Mehanna and Haggag, 2010 & 2011)**. A large family of surplus production models exists now, but all of them are similar to the classical **Schaefer (1954&1957)** and **Fox (1970&1975)** models. In the stock assessment studies, the effort and catch per unit fishing effort statistics are essential as they constitute the basic input for the surplus production models **(Mehanna and El-Gammal, 2007)**. The surplus production models allow estimating the optimum level

of effort that produces the maximum sustainable yield without affecting the long-term productivity of the stock.

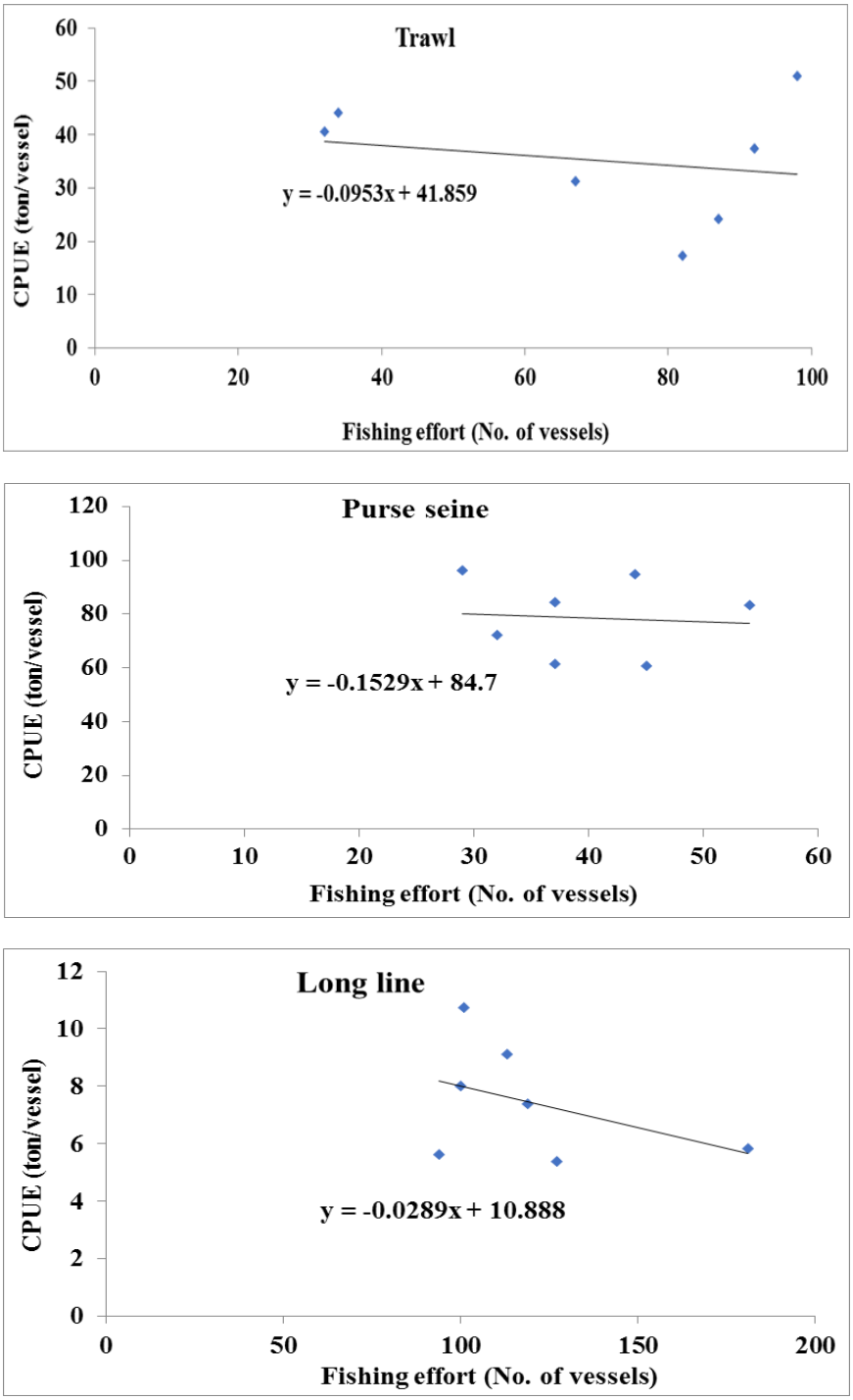

Fig. 9. CPUE (ton/No. of vessels) for the three fishing methods in Port of Tangier

One of the major challenges to manage and develop of the fish resources in Port Tangier is the lack of time series statistics (just seven years are available), the lack of reliable data on catch, different units of fishing effort, age composition and size composition, and the lack of statistics concerning the catch by species for different fishing gears operating in Port Tangier. In the present study, the total catch by fishing gear and the fishing effort represented by the number of fishing vessels were analyzed to give a preliminary evaluation about the status of the Port Tangier fishery. The surplus production model of **Schaefer (1954&1957)** was applied to estimate MSY and f_{opt} of the trawl, purse seine and longline fisheries operating in the port of Tangier, also 2/3 f_{MSY} as a target reference point has been determined.

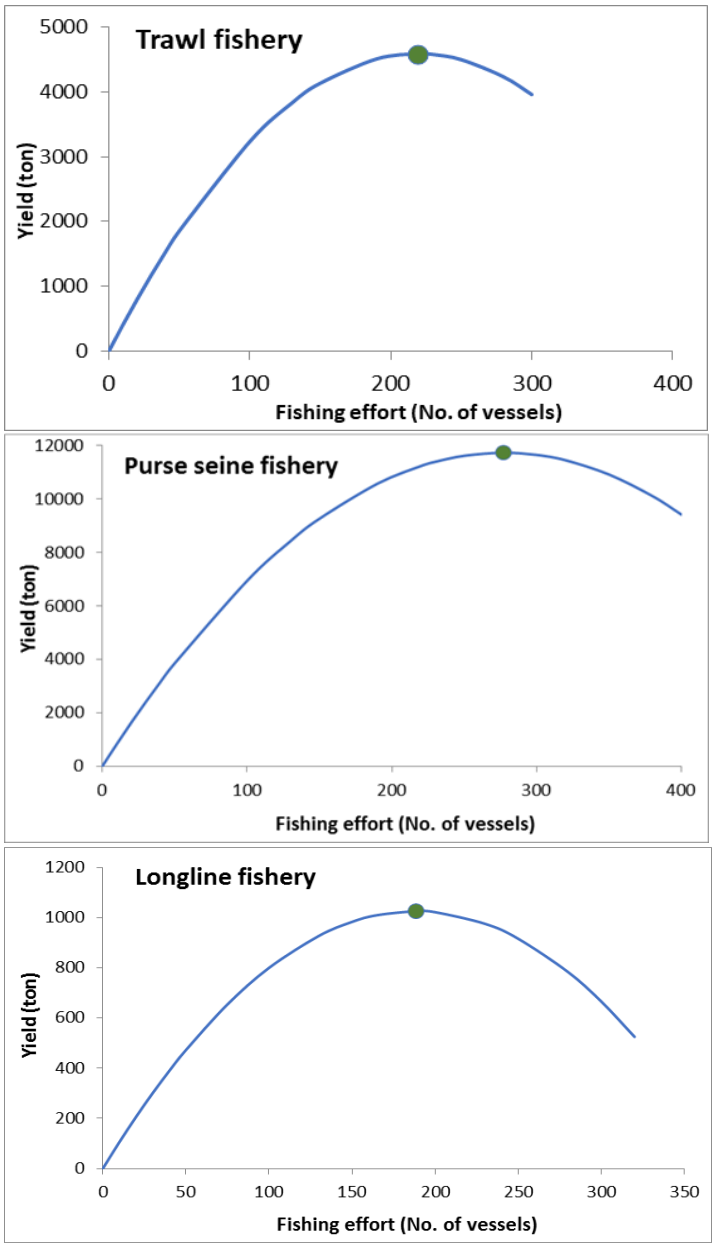

Fig. 10. MSY and fMSY for the different fishing gears in the port of Tangier

The results (Fig. 10) showed that a maximum sustainable yield of about 4582, 11730 and 1026 ton could be obtained from trawl, purse seine and longline fisheries respectively. The estimated optimum fishing effort was 218, 276 and 188 fishing vessels for trawl, purse seine and longline fisheries respectively. This means that, the present level of fishing effort of trawl and purse seine fisheries could be expanded to obtain MSY, while for longline the catch could be increased by about 94% of its current value by applying the current number of vessels.

The 2/3 f_{MSY} (the fishing at effort level which allow about 80% of the MSY to be harvested with a significant reduced risk) as a target reference point was estimated for the long line fishery. The results revealed that the catch could be increased by about 72% through reducing the number of fishing vessels by 31% of its current number.

CONCLUSION

In conclusion, based on the obtained results there is an opportunity to expand the trawl and purse seine fishery in the port of Tangier, but before any increasing in fishing effort more data and more years should be available. Also, continue the study using the analytical models to assess and manage the different fish stocks exploited by different fishing gear in the port of Tangier. As well as, make a data base about the Port of Tangier fishery containing good records for fishery statistics to facilitate the evaluation and managing this valuable fish resource.

REFERENCES

Atmani, H. (2003). Moroccan fisheries a supply overview. Report of the expert consultation on international fish trade and food security (Casablanca, Morocco, 27–30 January 2003). FAO Fisheries Report, (708), pp.163-177.

Boudinar, B. (2007). Diagnostic du secteur de la pêche maritime au Maroc, pp. 1-181.

Darasi, F. and Aksissou, M. (2019). Assessment of the Coastal Fisheries of the Tangier Port, Morocco 2011-2017. European Journal of Engineering Research and Science, 4(8), pp. 90-94. DOI: http://dx.doi.org/10.24018/ejers.2019.4.8.1473.

Daurès, F, Rochet M. J, Van Iseghem S, Trenkel V. M. (2009). Fishing fleet typology, economic dependence, and species landing profiles of the French fleets in the Bay of Biscay, 2000-2006. Aquatic Living Resources. 22(4): 535-547.

Fox Jr, William W. (1970). An exponential surplus yield model for optimizing exploited fish populations. Trans. Am. Fish. Soc. 99: 80-88.

Fox, William W. (1975). Fitting the generalized stock production model by least-squares and equilibrium approximation. Fishery Bulletin. 73: 23-37.

Hilborn, R., Walters, C. J. (1992). Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Rev Fish Biol Fish. 2(2) : 177-178.

INRH/DP. (2017). Rapport annuel de l'Etat des stocks et des pêcheries marocaines2017. Institut National de recherche Halieutique, Casablanca (Maroc) - ISSN : 2509-1727, 287.

Islam, G. M. N, Noh, K. M, Yew, T. S. (2011). Measuring productivity in fishery sector of Peninsular Malaysia. Fisheries Research. 108: 52–57.

Mehanna, S. F, El-Gammal, F. I. (2007). Gulf of Suez fisheries: current status, assessment and management. J. King Abdulaziz University, Mar. Sci. 18: 3-18.

Mehanna, S. F, Haggag, H. M. (2010). Port Said Fisheries: current status, assessment and management. In: Proceedings of the3rd global fisheries & aquaculture research conference, 29th November–1st December. Foreign Agricultural Relations, Egypt, 289–303.

Mehanna, S. F, Haggag, H. M. (2011). Maximum sustainable yield of the flatfishes (Family: Soleidae) from Port Said waters, Mediterranean Sea. Egypt. J. Aquat. Biol. & Fish. Vol. 15, No. 3 :285- 293.

ONP. (2017). Données statistiques de Office National de la Pêche de Tanger.

Prager. M. H. (2004). User's manual for ASPIC: A Stock - Production model Incorporating Covariates (ver. 5) and auxiliary programs. National Marine Fisheries Service, Beaufort Laboratory, Document BL-2004-01. 25.

Quinn, T. J, Deriso, R. B. (1999). Quantitative fish dynamics. Oxford University Press, New York.

Sathianandan, T. V., Jayasankar, J., Vivekanandan, E., Narayanakumar, R., Pillai, N. G. K. (2008). Estimates on potential yield and maximum sustainable fleet size for marine fisheries in Kerala. Journal of the Marine Biological Association of India. 50(2): 196-201.

Schaefer, M. B. (1954). Some aspects of the dynamics of populations important to the management of the commercial marine fisheries. Inter-American Tropical Tuna Commission Bulletin. 1(2): 23-56.

Schaefer, M. B. (1957). A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Inter-American Tropical Tuna Commission Bulletin. 2(6): 243-285.

Squires, D. (1994). Sources of growth in marine fishing industries. Marine Policy. 18: 5–18.

Tai, S. Y, Hussein, M. A. B. (1997). Measuring Productivity in Multispecies and Multigear Fishery Sector of Peninsular Malaysia, Paper Presented at the Forum on Productivity in Agricultural Sector, Hotel Hyatt Saujana, 20 September.

Van Phuong, T., Trong Huyen, P., Fridriksson, K. S. (2016). Estimating the maximum sustainable yield for coastal fisheries: A case study in Nui Thanh District, Quang Nam Province, Viet Nam. Secretariat, Southeast Asian Fisheries Development Center.

Wiyono, E. S., Simbolon, D., Solihin, I. (2018). Estimation of the utilization rate of fish resources in the northern coast of Java, Indonesia. Aquaculture, Aquarium, Conservation & Legislation. 11(6):1807-1824.