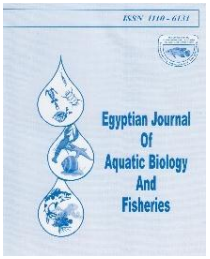
Egyptian Journal of Aquatic Biology& Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 25(5): 271 – 296 (2021)
www.ejabf.journals.ekb.eg



Characterization of the artisanal fishery in the projected marine protected area "Jabal Moussa".

Mohamed Rida Derdabi[1, 2*], Mustapha Aksissou[1]
1 Team ESCB, Department of Biology, Faculty of Sciences B.P. 2121, Tetouan, Morocco
2 Fishing site of Belyounech, M'diq maritime fisheries office, Morocco
[*]**Corresponding Author: medridaderdabi@gmail.com**

ARTICLE INFO
Article History:
Received: May 28, 2021
Accepted: July 28, 2021
Online: Sept. 8, 2021

Keywords:
Artisanal fishery,
Protected area
Jabal Moussa,
Socio-economic data,
Fleet characteristics,
Fishing gears.

ABSTRACT

This study was carried out in the marine part of the projected protected area «Jabal Moussa », overlooking the Strait of Gibraltar. It aimed to clarify the characteristics of the artisanal fishery, with the ecological significance and to provide baseline information to help in developing suitable management measures. Data were collected from April 2018 to May 2019, through detailed surveys and structured interviews to analyze fleet features, species and landing composition, fishing gears, and socio-economic data such as age, experience, capital invested, gross product, etc... where 293 fishermen were interviewed. For skippers, the average age was 51.4 ±11.2 years and 32.5 ±9.6 years for seamen. The crew was small (2-4 people/boat). It was noted that, 84% of fishermen did not want their children to become fishermen, while 46% of fishermen declared their desire to change their job. A total of 14267 fishing trips were recorded and 160.529 Kg of biomass composed of 31 species belonging to 9 orders were landed by 99 fishing boats, using 8 different gears; mainly, the blackspot seabream longline. The capital invested was 4.680.800 MAD and the gross product was 22.185.246 MAD.

INTRODUCTION

The Artisanal fishery is a traditional activity, using limited capital, often deprived of technology, using small wooden boats, with low tonnage, and generally operated by the owner (**Griffiths *et al.*, 2007; Falautano *et al.*, 2017**). Fishing sites are small, geographically dispersed, which makes data collection very difficult. The infrastructure is generally basic (**Camiñas *et al.*, 1991; Farrugio, 1991; Féral, 2001**). The fishing grounds are generally close to ports, fishing trips are short and never exceed 24 hours (**Matic-Skoko *et al.*, 2011; Guyader *et al.*, 2013; Falautano *et al.*, 2017**). However, there is no common definition for artisanal fisheries; this may vary from one country to another depending on the general context. The United Nations for Food and Agriculture defined artisanal fishery as "*Traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption. In practice, the definition varies between countries, e.g. from gleaning or a one-man canoe in poor developing countries, to more than 20 m trawlers, seiners, or long-liners in developed ones. Artisanal fisheries can be subsistence or commercial fisheries, providing for local consumption or export. Sometimes referred to as small-scale fisheries*" (**FAO, 2005**).

Despite this, artisanal fishery plays an important role in poverty alleviation, in supplementation of animal proteins, and sustainable development in the world, especially in developing countries where 90% of the activity is carried out (**FAO, 2005, 2016 a**).

In the Mediterranean Sea, the artisanal fishery has been practiced for thousands of years and has always played an important socio-economic and cultural role (**Farrugio *et al.*, 1993; Guidetti *et al.*, 2010; Guidetti, 2012**). It is contributed to strengthening people's attachment to their territory, enriched them with large experiences and traditions transmitted from one generation to another, in addition to participating in the establishment of a harmonious relationship between the coastal populations and the marine environment (**Battaglia *et al.*, 2010; Guyader *et al.*, 2013 ; Falautano *et al.*, 2017**). Artisanal fishery in the Mediterranean Sea has gradually progressed compared to the last decades; the majority of artisanal boats are now equipped without board motors (**Di Franco *et al.*, 2014**). The fishery is multispecific, targeting a wide range of resources, including high-value species and using different fishing techniques and gears (**Farrugio *et al.*, 1993; Falautano *et al.*, 2017**). It is considered a heterogeneous fishery due to the great diversity of the gears used, the duration of the fishing operations, the landings sites, and the destination of the products (**Battaglia *et al.*, 2009; Falautano *et al.*, 2017**).

Despite its importance, studies concerning artisanal fishery in the Mediterranean are generally scarce. However, some studies have been carried out in Italy (**Arculeo & Riggio, 1983; Ardizzone, 1985; De Metrio *et al.*, 1985; Whitmarsh *et al.*, 2003; Colloca *et al.*, 2004; Copolla, 2006; Battaglia, 2009; Battaglia *et al.*, 2010; Falautano *et al.*, 2017**), Tunisia (**Jabeur *et al.*, 2000**), Greece (**Tzanatos *et al.*, 2005, 2006; Stergiou *et al.*, 2006; Merino *et al.*, 2007**), Spain (**García-Rodríguez *et al.*, 2006; Piniella *et al.*, 2007; Merino *et al.*, 2008; Reglero & Morales-Nin, 2008; Maynou *et al.*, 2013**), Lebanon (**Pinello *et al.*, 2013**) and Algeria (**Boubekri *et al.*, 2018**).

Recently, more attention has been paid to the artisanal fishery in the Mediterranean basin in order to expand knowledge, preserve cultural heritage, and protect resources regarding its different aspects (**Falautano, 2018**). A global approach, integrating all the Mediterranean fisheries, is needed to adopt an effective management plan.

In Morocco, the artisanal fishery has often been neglected and poorly managed due to its geographical distribution in remote areas and the difficulty of controlling illegal fishing activities, combined with weak organization (**Ramos-Esplá *et al.*, 2004**). Some studies analyzing the artisanal fishing activity have been carried out in the Moroccan Mediterranean Sea, such as the study on the exploitation and socio-economic aspects of the artisanal fishery in the Nador Lagoon (**Mallouli Idrissi, 2002**), and the study on the situation of artisanal fishery after the opening of the new channel in the Nador Lagoon (**Najih, 2015**).

Therefore, this study aimed at investigating and analyzing the characteristics of the fleet, the catches, the composition of fish landed, the fishing techniques, the socio-economic aspects such as the capital invested, the gross product, the monthly net product, and other aspects of the fishing activity in the marine part of the projected protected area « Jabal Moussa », with ecological significances (**PNUE/PAM-CAR/ASP, 2016**). Moreover, the current study was targeted to provide a baseline

information to help develop appropriate management measures and enrich the information network on artisanal fisheries in the Mediterranean basin.

MATERIALS AND METHODS

1 Study area

This study was carried out in the marine part of the projected protected area « Jabal Moussa ». It is located in the strait of Gibraltar and concerns the fishing sites existing in this area (Belyounech, Oued El Marsa, and Dalia) (Fig. 1)

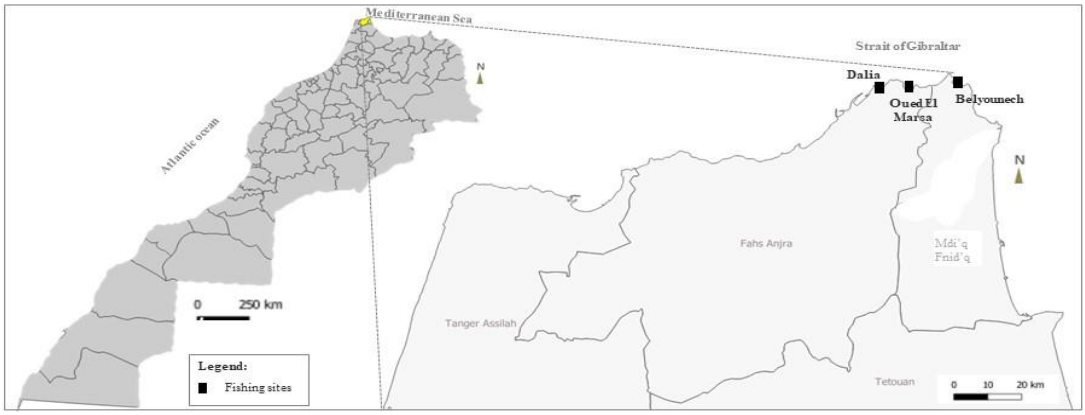


Fig. 1. Fishing sites within the projected marine protected area Jabal Moussa (QGIS 3.20)

The area is characterized by a strategic position between the Atlantic Ocean and the Mediterranean Sea. The study that was carried out in this area between 2014 and 2015 as part of the project Medkey habitats found 175 taxa, belonging to 15 taxonomic groups. Among the species identified, many are still protected by the legislation of the European Union and Mediterranean (Bern Convention, Barcelona Convention, CITES and the IUCN Red List of Threatened Species), such as the coral "*Corallium rubrum"*, the seagrass "*Zoostera marina"*, the seaweed "*Litophyllum byssoides"*, the anthozoas "*Astroides calycularis*," "*actinia equine*" and "*Paramuricea clavata"*,and the Ascidiaceas "*Polycitor adriaticum"* and "*Halocynthia papillosa"*, which are bio-indicator species of clear waters.

In the study area, many marine mammals listed in the red list of the IUCN are present, such as the pilot whale "*Globicephala melas"*, the killer whale "*Orcinus orca"*, the short-beaked common dolphin "*Delphinus delphis*", and the common bottlenose dolphin "*Tursiops truncates*" (**IUCN, 2012**). Other protected species such as sperm whales (*Physeter macrocephalus*) and fin whales (*Balaenoptera physalus*) have been detected during their migration (**Perez-Gimeno *et al.*, 2004**).

The results of these studies show that the site, with its ecological importance, has all the criteria to be proposed as a marine protected area (**PNUE/PAM-CAR/ASP, 2016**).

2 Data collection

Data were collected between April 2018 and May 2019, through direct individual and/or group interviews with fishermen and field surveys, and information on active boats, registration number, length, gross tonnage, and power horse was obtained from the Tangier and M'diq fishing offices. For each active boat, two types of surveys were adopted: (a) a survey on socio-economic aspects such as crew composition, age, experience, level of education, social coverage, membership in a cooperative or association, costs, income, maintenance expenses, etc.; (b) a survey on fishing operations such as duration of fishing trips, fishing grounds, bait used, characteristics of the gears used, their local name, etc… For catch and effort surveys, these were conducted from June 2018 to May 2019 and collected information on departure and return time to the fishing site, catch weight and composition, prices, and gear used.

3 Selected indicators

The indicators analyzed in this study are:

*Capital invested: an indicator of the present value of the means of production (boat, engine, gears);

*Total production costs: This is an indicator of annual costs. It is composed of annual fixed costs (amortization, fishing rights, and maintenance costs) and common costs (fuel, lubricant, food…). It is determined by applying the following formula

$$CC = \sum_{j=1}^{m} Outing\ sea\ \ j\ x\ (Fu\ \ j + Lu\ \ j + F\ \ j)$$

Fishing trips j: Number of fishing trips during the month j
Fu j: Cost of fuel consumed during month j
Lu j: Cost of lubricant consumed during month j
Fj: Food used during the fishing trips in month j

*Salary expenses: The remuneration of fishermen was done according to a sharing system
(**Diaw, 1989**)

$$SE = \sum_{j=1}^{m} (GP\ j - CC\ j)\ x\ (Cr\ j - a\ j) \Big/ 2\ Cr\ j$$

GPj: Gross product for month j
CCj: Common costs for month j
Crj: Crew size
Aj: indicator = 1 if the owner is part of the crew during month j (the common case) and 0 otherwise. (In this study we consider that aj = 1)
m: Total number of fishing trips

*Gross product: This is an interesting economic indicator that measures the value of the fish landed (**Marshall *et al.*, 1981**).It is determined by applying the following formula

$$GP = \sum_{j=1}^{m} \sum_{i=1}^{n} Pij \ x \ Qij$$

Pij: Price of the species i during the fishing trips j in MAD
Qij: Quantity of species i sold during the fishing trips j in Kg
n: Number of species caught
m: Number of fishing trips

*CPUE: Catch per unit effort was calculated using the formula of **Gunarso & Wiyono, 1994**:

$$CPUE = \frac{Ci}{Ei}$$

Ci: Catch in month i (Kgs)
Ei: Effort in month i (Trips)

*Statistical tests:

Statistical tests were performed by XLTSTAT 2019:

- The t-student test was used to compare age and experience between skippers and seamen.
- The ANOVA test was used to compare length, power engine, and gross tonnage of the fleet across the three fishing sites.

RESULTS

1 Data on fishermen

Among the 293 fishermen interviewed, 50% had attended the Qur'anic school while 32% had never gone to school (Fig. 2). Their average age was 51.4 ±11.2 years for skippers (with a minimum of 26 years and a maximum of 72 years), and 32.5 ±9.6 years for seamen (with a minimum of 18 years and a maximum of 56 years). Their average experience was 33.2 ± 11.6 years for skippers (with a minimum of 8 years and a maximum of 55 years) and 14.5 ± 8.8 years for seamen (with a minimum of 1 year and a maximum of 40 years).

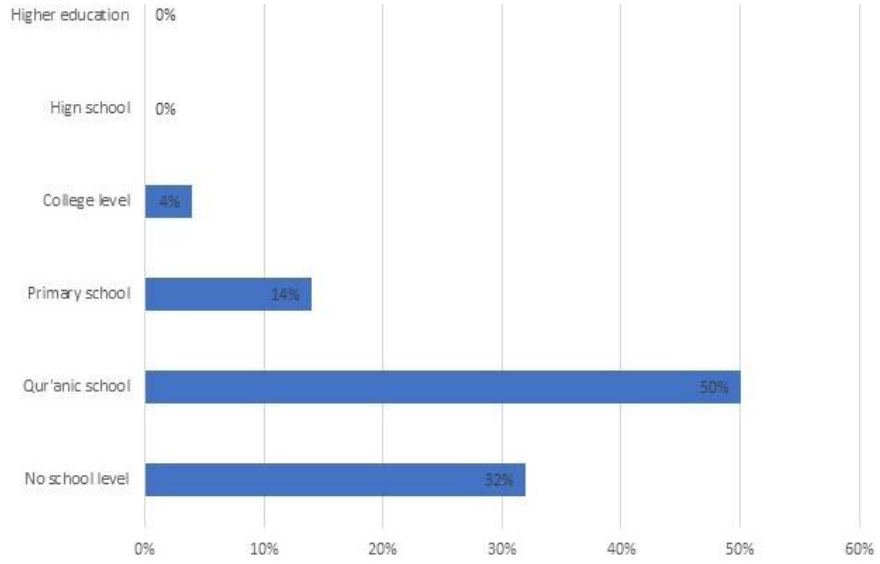


Fig. 2. Educational level

The Student's t-test ($p < 0.05$) was used to compare the mean ages and experience of fishermen and skippers. For the age parameter, H0 represents an equal mean age between skippers and seamen, and H1 represents the difference in mean age between skippers and seamen. For the experience parameter, H0 represents equal mean experience between skippers and seamen, and H1 represents the difference in mean experience between skippers and seamen. Before performing the Student's t-test, the normality of the variance of the data was tested using the Shapiro-Wilk test. The calculated values were less than 0.05; therefore, the hypothesis of equality of means can be rejected and excluded, hence, it was concluded that the means of age and experience of the skippers and seamen were statistically significantly different.

A percentage of 65 of the boats had 3 crew members, and the rate of boats with 2 and 4 crew members was 17% and 18%, respectively. Increasing the number of seamen may increase technical efficiency within the capacity of the fishing boats, but it is not necessarily financially optimal (Fig. 3).

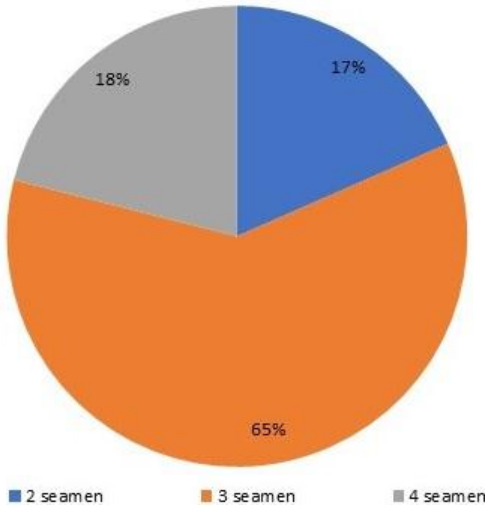


Fig. 3. Crew composition

135 fishermen out of 293 expressed their desire to change jobs. 35% of them wanted to work in Spain (especially fishermen from Belyounech), and 41% wanted to join the Tangier Med project. 87% of the 137 fishermen with male children had the desire to change their jobs, probably because of the risk of their son’s possible involvement in fishing. 78 % of the fishermen received maritime safety training at the Institute of Fishing Technology in Larache, but no other type of training was provided. All fishermen were affiliated to the national social security system. Of the 73.4% of fishermen who were married, 81.4% had children. Each fisherman could take charge of up to 5 family members. Regarding the origin of fishermen, a large fraction of them came from the surrounding agglomerations called « Douars » and they could usually reach the fishing site on foot.

2 Economic data

2.1 Capital invested

The total capital invested in the study area was 4.680.800 MAD, with differences in investment from one site to another, mainly related to the fishing gear used and the number of boats. It was respectively 1.913.800 MAD in Belyounech, 886.000 MAD in Oued El Marsa, and 1.881.000 MAD in Dalia. Investment in engines represented a large part of the overall investment with 44%, followed by boats with 32% and gear with 24% (Fig. 4).

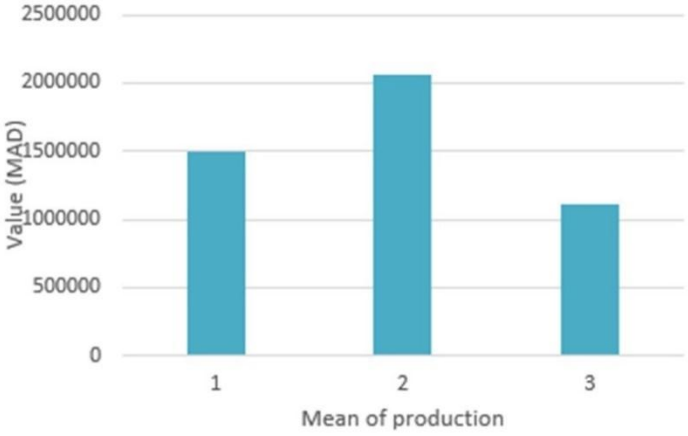


Fig. 4. Capital invested

On the other hand, in the majority of cases, the acquisition of the means of production is done through personal savings, despite the existence of other means of financing, but to a lesser degree, such as family mutual aid. Some fishermen stated that they did not have access to bank credit because of the lack of repayment guarantees.

2.2 Production costs

2.2.1 Fixed costs

Annual fixed costs of production were generally related to gear maintenance, boat maintenance, engine maintenance, taxes, insurance costs and gear amortization (Fig. 5).

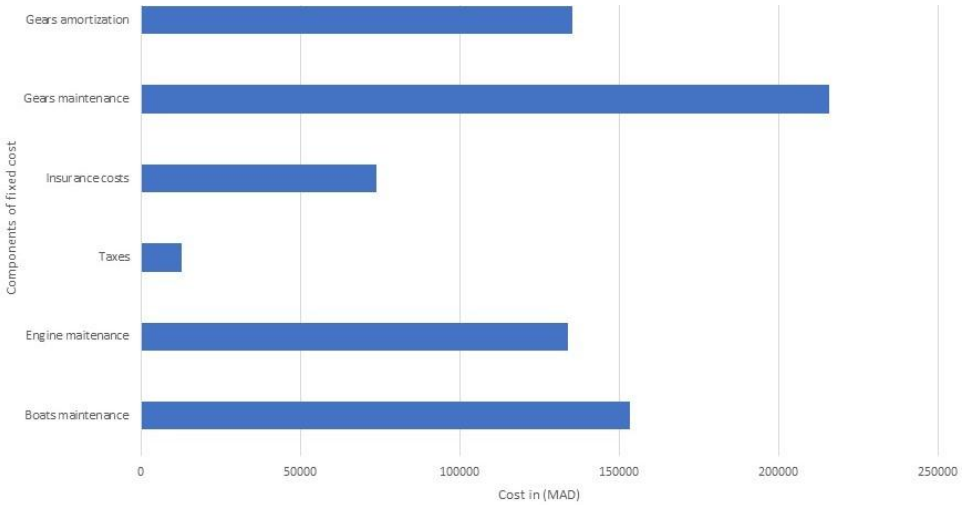


Fig. 5. Fixed costs in the study area

In the study area, fixed costs were estimated at 724.960 MAD, of which 330.930 MAD in Belyounech, 133.280 MAD in Oued El Marsa, and 260.750 MAD in Dalia. The annual fixed costs per boat were 7323 MAD. These costs are composed of gears maintenance with 215.950 MAD, corresponding to 30% of the total costs, boat maintenance with 153.300 MAD, corresponding to 21%, gear amortization with 135.370 MAD, corresponding to 19%, engine maintenance with 133.800 MAD, corresponding to 18%, insurance costs with 73.920 MAD, corresponding to 10% and license costs with 12.620 MAD, corresponding to 2% of the total cost.

2.2.2 Common costs

Common costs were generally related to fuel, lubricant, and bait consumption for boats using lines. Ice and food costs are generally overlooked due to the short duration of the fishing trip. These costs are shared between the boat owner and the fishermen. The total estimated cost in the three fishing sites was 3.377.309MAD, with 1.393.635 MAD in Belyounech, 569.618 MAD in Oued El Marsa, and 1414056 MAD in Dalia (Table 1). It was mainly dominated by bait and fuel costs.

Table 1. Common cost (CC) in the study area

	Annual Common Costs	Number of Boats	CC/Boat/ Year	CC/Boat/Month	No. of Fishing Trips/Boat/Month	CC/Boat/Fishing Trips
Belyounech	1393635	38	36675	3056	11.53	265
Oued El marsa	569618	19	29980	2498	12.31	203
DALIA	1414056	42	33668	2806	12.30	228
Total	3 377 309	99				
Average			33441	2787	12.05	232

2.3 Salary expenses

Data collected revealed that, 65% of the boats had 3 fishermen in the crew, 18% had 4 fishermen and 17% had 2 fishermen. We assumed that the salary expenses were assumed to differ from one boat to another, thus influencing the differences in the optimal number of the crew. Hence, 3 scenarios were suggested and are presented in Table (2).

Table 2. Fishermen salary expenses in the study area

	Scenario 1	Scenario 2	Scenario 3
Number of Crew	2	3	4
No. of Fishing Trips/ Year	14267	14267	14267
No. of Fishing Trips/ Year / Boat	144	144	144
No. of Fishing Trips/ Month/ Boat	12	12	12
Total Salary Expenses (MAD)	4.701.984	6.269.312	7.052.976
Salary Expenses/ Month (MAD)	391.832	522.442	587.748
Number of Boats	99	99	99
Salary Expenses/ Month / Boat (MAD)	3958	5277	5937
Salary Expenses/ Fishing Trip/ Boat (MAD)	330	440	495

It was noted that, the salary expenses are directly linked to the number of fishing trips and automatically to production volume, common costs, and crew composition. Moreover, salary expenses increase proportionally with the number of crew members. The salary expenses for boats with 2 fishermen were 330 MAD; for 3 fishermen the expenses were 440 MAD, and for 4 fishermen the value was 495 MAD.

2.4 Gross product

The gross product was obtained by multiplying the quantities of fish caught in the region by the average prices of the different species. It was estimated at 22.185.246 MAD.

2.5 Monthly net income

The net value produced by the boat per month is the monthly gross product minus the monthly fixed costs, monthly common costs, and monthly salary costs.

The monthly net income per boat in the area was high due to the targeted species, especially the blackspot seabream "*Pagellus Bogaraveo*", which has a very high commercial value. This income was proportionally related to the number of crews as shown in Table (3). The collected data showed that 65% of the boats in the region had a monthly income of 10.610 MAD.

Table 3. Monthly net income in the study area

	Scenario 1	Scenario 2	Scenario 3
Fishermen Number	2	3	4
Annual Gross Product	22.185.246	22.185.246	22.185.246
Monthly Gross Product	1.848.770	1.848.770	1.848.770
Monthly Gross Product/ Boat	18674	18674	18674
No. of Fishing Trips /Month/ Boat	12	12	12
Gross Product / Fishing Trips/ Boat (MAD)	1556	1556	1556
Common Costs/ Fishing Trips/ Boat (MAD)	232	232	232
Salary Expenses/ Fishing Trips/ Boat (MAD)	330	440	495
Monthly Variable Costs/ boat (MAD)	6744	8064	8724
Monthly Net Income per Boat (MAD)	**11930**	**10610**	**9950**

3. Means of production

3.1 Characteristics of the fleet

The fishing fleet in the projected marine protected area « Jbel Moussa » was composed of 99 active wooden boats: 42 in Dalia, 38 in Belyounech, and 19 in Oued El Marsa. They were small with length ranging from 4.3 to 6.65 m (average 5.60 m ± 0.34), engine power from 8 to 25 HP (average 17.15 HP± 3.34) and gross tonnage from 0.91 to 1.79 t (average 1.49± 0.17). The fleet in the region ranged in age from 2 to 37 years with a mean age of 10.94 ± 5.91 years.

The analysis of variance (ANOVA) statistical test was used to compare three parameters (length, engine power, and gross tonnage) within the three sites.

For the length parameter, H0 represents the same average length of the boats in the three sites (H0: ML Belyounech=ML Oued El Marsa= ML Dalia and H1: at least one average is different from the others. For the engine power parameter, H0 represents the same average engine power of the boats in the three sites (H0: MEP Belyounech=MEP Oued El Marsa= MEP Dalia and H1: at least one average is different from the others, and for the gross tonnage parameter, H0 represents the same average gross tonnage of the boats in the three sites (H0: MGT Belyounech=MGT Oued El Marsa= MGT Dalia and H1: at least one average is different from the others.

The results of the analysis of variance (ANOVA) showed that there was no difference between engine power, gross tonnage and fleet length in the study area ($p > 0.05$). Table (4) summarizes the mean values of the fleet characteristics obtained.

Table 4. Average values of fleet characteristics in the study area

Site	Boat Number	Parameter	Length (m)	GT (t)	HP	Age (years)
Belyounech	38	Max	6.13	1.79	25	33
		Min	4.8	0.99	8	2
		Average	5.57±0.06	1.48±0.03	17.18±0.55	11.81± 5.82
Dalia	42	Max	6.65	1.79	25	18
		Min	4.95	1.07	15	2
		Average	5.63±0.05	1.52±0.03	17.26±0.52	9.24±4.56
Oued El Marsa	19	Max	6.2	1.79	25	37
		Min	4.3	0.91	15	3
		Average	5.62±0.08	1.45±0.04	16.84±0.77	12.95±7.76

3.2 Gears

Eight fishing gears were identified in the study area: Trammel Net, Surface Gillnet, Bottom-set Gillnet, Longline with Small Hooks, Longline with Large Hooks, blackspot seabream Longline, Handline, and octopus Jig. In Belyounech, Handline was not used by any boat and 2 boats had Bottom-set Net but were never used during the survey period, but all the other techniques were used. In Dalia, 5 techniques were used: Longline with Small Hooks, Longline with Large Hooks, blackspot seabream Longline, Surface Gillnet, and Trammel Net. At Oued el Marsa, 4 techniques were used: Longline with Small Hooks, blackspot seabream Longline, Handline, and Trammel Net. The most used gear in the area was the blackspot seabream Longline with a contribution of 108.053 Kg, corresponding to 67% of the total catch, followed by the Small Hook Longline with 22.962 Kg, corresponding to 14% of the total catch and the Trammel Net with 11.259 Kg, corresponding to 7% of the total catch, while all the other types of gears were responsible for 18.255 Kg, corresponding to 12 % of the total catch. The monthly contribution of each gear in the total catches is summarized in Fig. (6).

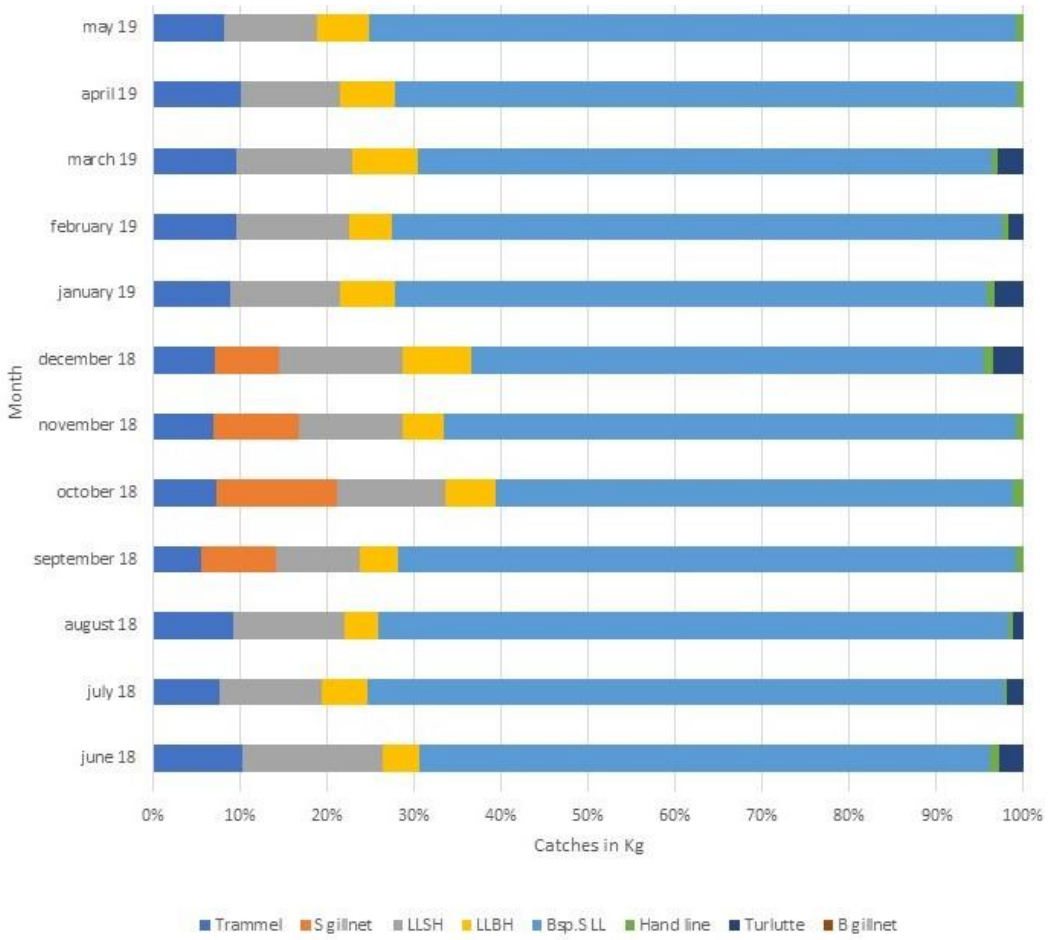


Fig. 6. Monthly contribution of the gears in the study area

The analysis of Fig. (6) shows that the blackspot seabream longline, small hooks longline, trammel net, large hooks longline and handline were used throughout the year. However, the monthly contribution to the total catch varied among the gears. The largest monthly contribution was made by the blackspot seabream longline, while the smallest contribution was made by handline. The use of the surface gillnet was related to the migration of small pelagics such as Bullet tuna, Skipjack tuna, Plain bonito, Little tunny, etc… The use of Octopus jig was dependent on the biological rest of the octopus; there were two seasons when the octopus could be exploited (June to August and December to March).

The same boat may use more than one technique during a fishing trip. The most common combination was the blackspot seabream longline with small hooks longline. It was noted that 96% of the boats were equipped with blackspot seabream longline, 73.7% with small hooks longline and 59.6% with large hooks longline. The characteristics, target species, fishing areas and fishing periods were all identified for each gear used in the study area (Table 5).

Table 5. Fishing gears characteristics, target species and fishing periods

Gear	Characteristics	Target species	Fishing period
Blackspot seabream Longline	It is a longline used in high depths (200 to 500 m). The length of the main line is 100 m (0,8 to 1,2 mm of diameter), added to a rope of 500 m. The branch line length is between 0,5 and 1 m (0,5 mm of diameter). The sizes of the hooks used are 10,11 and 12, with a total number of hooks per gear ranging between 50 and 150. The bait used is sardine, sardinella and atlantic mackerel. The duration of fishing time is short and doesn't exceed 3 hours.	Blackspot seabream	Throughout the year
Small Hooks Longline	It is a line with 500 to 3000 m long (1,2 - 1,8 mm of diameter), and branch line with 1 to 1,5 m long (0,4-0,5 mm of diameter). The hook sizes vary between 9 and 14, with a total number of hooks per gear ranging between 100 and 500. The bait used is sardine, sardinella,atlantic mackerel and cuttlefish. The duration of fishing time is between 3 and 8 hours.	Common pandora; European seabass; Common seabass;	Throughout the year
Large Hooks Longline	It is a line with 500 to 3000 m long (1,8 - 3 mm of diameter), and branch line with 1 to 1,5 m long (1,2 mm of diameter. The sizes of hooks used are 5 and 6, with a total number of hooks per gear ranging between 100 and 200. The bait used is sardine, sardinella,atlantic mackerel . The duration of fishing time is between 6 and 8 hours. The fishing operation starts generally around 4 pm.	Bluespotted seabream; Dogtooth grouper; Dusky grouper; Forkbeard; Rubberlip grunt; European conger; Common dentex; Mediterranean moray.	Throughout the year
Handline	The main line used is 30 to 200 m long (0,4- 0,7 mm of diameter), and the branch line with 30 cm long (0,4 mm of diameter). The sizes of the hooks used ranges between10 and 16. Number of hooks used is generally between 3 and 5. The bait used is sardine, sardinella, smooth clam and grooved razor shell. The duration fishing time is between 4 and 8 hours.	Saddled seabream; Scomber; Bogue; Zebra seabream; Black seabream; Common two banded seabream; Axillary seabream.	Throughout the year
Octopus Jig (Turlutte)	The gear is made of a line with 20 to 300 m long, in its extremity, there is a cylindrical piece made of lead or wicker provided with 5 to 6 hooks, whose sizes vary between 4 and 6. The bait used is sardine, sardinella and chicken legs. The fishing operation takes generally the whole day, from 6 am to 7 pm, depending on the fishing ground.	Octopus.	Throughout the year with the exception of the biological rest periods
Trammel Net	The gear consists of 3 layered nets: the first one is in the middle with small mesh between 25 and 40 mm, sandwished between two nets with large mesh (50 to 60 mm). The length varies between 500 and 3000 m, depending on the number of pieces composing the trammel, the length of one piece varies between 50 and 100 m, and the height vary between 2 and 4 m.	European lobster; Spinous spider crab; Horse mackerel; Common spiny lobster; Mullet; Sole; Cuttlefish;	Throughout the year

		Piper gurnard; Turbot	
Surface Fixed Gillnet	The gear is made by a single layer of 1000 m long and 8m of depth. The mesh used range between 0, 35 and 0, 5 mm. The net is kept in the water and the fisherman comes back every morning to collect the trapped fish.	Bullet tuna; Skipjack tuna; Plain bonito; Little tunny.	August-December

3.3 Fishing effort

3.3.1 Annual fishing effort

In the study area, 99 active boats were identified and 8 fishing techniques were used. It was observed that the most used fishing gear was the blackspot seabream longline. The level of activity of these boats allowed the researchers to assess the fishing effort evaluated by the number of trips at sea. The total fishing effort during the study period was estimated at 14.267 trips, with a proportional difference from one site to another, depending on the number of active boats. The average number of fishing trips per boat during the study period was 144 (Table 6).

Table 6. Sea trips in the study area

	Belyounech	Oued Marsa	Dalia	Total	Average
Total Sea Trips	5259	2806	6202	14267	
Number of Boats	38	19	42	99	
Sea Trips/ Boat/ Year	138	147	147		144

The duration of the fishing trip was relatively low and depended directly on the fishing technique and ground; it did not exceed 24 hours. The time needed to reach the fishing ground from the fishing site varied between 30 minutes and one hour. Once they get back at the fishing site, the fishermen should repair the damaged gears and prepare for the next trip.

3.3.2 Monthly fishing effort

Monitoring of the evolution of monthly fishing effort revealed the presence of periods of high activity (June-July, September, March-April) and periods of low activity (August, October to February). April recorded the highest activity, while January witnessed its lowest (Fig.7). The average number of trips per month per boat was 12 (with 11.53 in Belyounech, 12.3 in Oued El Marsa, and 12.3 in Dalia).

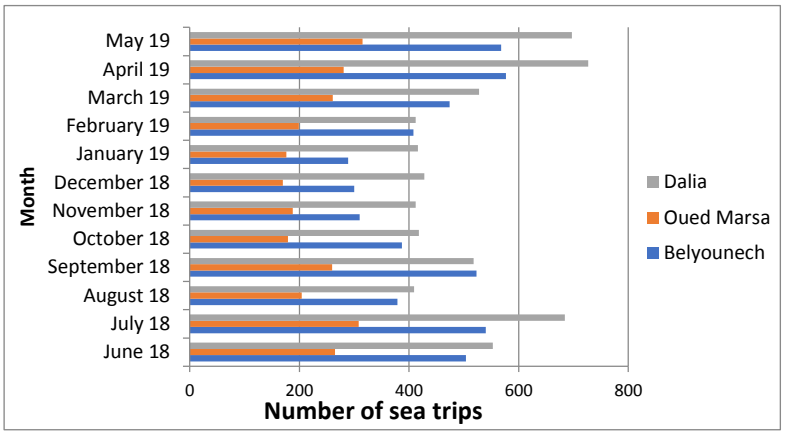


Fig. 7. Monthly fishing effort in the study area

3.3.3 Catch per unit effort (CPUE)

The Monthly CPUE of the target species is presented in Table (7)

Table 7. Monthly CPUE for species caught by the most used gears (Bsp.B LL: Blackspot seabream longline, LLBH: Large hooks longline, LLSH: Small hooks longline)

		Monthly CPUE											
Gear	Species	June	July	August	September	October	November	December	January	February	March	April	May
BSp.B LL	**BLACKSPOT SEABREAM**	**6,40**	**7,30**	**7,90**	**8,94**	**6,91**	**7,23**	**7,16**	**7,89**	**8,21**	**7,38**	**6,94**	**8,56**
LLBH	BLUESPOTTED SEABREAM	0,06	0,08	0,07	0,07	0,10	0,04	0,15	0,09	0,10	0,13	0,12	0,13
	DOGTOOTH GROUPER	0,02	0,00	0,00	0,03	0,00	0,03	0,02	0,02	0,02	0,02	0,01	0,02
	DUSKY GROUPER	0,02	0,00	0,00	0,04	0,00	0,04	0,02	0,01	0,01	0,00	0,00	0,00
	FORKBEARD	0,02	0,03	0,03	0,04	0,05	0,03	0,10	0,09	0,04	0,05	0,07	0,05
	RUBBERLIP GRUNT	0,05	0,07	0,03	0,10	0,09	0,09	0,12	0,12	0,10	0,18	0,12	0,09
	EUROPEAN CONGER	0,09	0,09	0,11	0,06	0,12	0,06	0,14	0,11	0,11	0,15	0,08	0,14
	COMMON DENTEX	0,05	0,11	0,07	0,12	0,15	0,09	0,17	0,16	0,11	0,15	0,09	0,13
	MEDITERRANEAN MORAY	0,09	0,15	0,11	0,10	0,17	0,11	0,22	0,15	0,10	0,15	0,13	0,14
Total LLBH		**0.41**	**0.54**	**0.42**	**0.55**	**0.68**	**0.5**	**0.94**	**0.74**	**0.57**	**0.83**	**0.62**	**0.70**
LLSH	COMMON PANDORA	0,16	0,13	0,11	0,10	0,12	0,07	0,12	0,04	0,05	0,03	0,02	0,02
	EUROPEAN SEABSS	0,04	0,04	0,03	0,04	0,03	0,02	0,02	0,02	0,03	0,02	0,01	0,00
	COMMON SEABREAM	0,50	0,31	0,53	0,42	0,62	0,49	0,76	0,54	0,63	0,62	0,49	0,46
	ZEBRA SEABREAM	0,07	0,06	0,04	0,04	0,04	0,04	0,03	0,04	0,03	0,03	0,02	0,03
	BLACK SEABREAM	0,04	0,03	0,02	0,02	0,03	0,04	0,02	0,02	0,01	0,02	0,02	0,02
	COMMON TWO BANDED SEABREAM	0,20	0,17	0,21	0,16	0,16	0,16	0,18	0,24	0,21	0,23	0,15	0,24
	GLITHEAD SEABREAM	0,05	0,03	0,02	0,05	0,01	0,02	0,00	0,01	0,00	0,00	0,00	0,00
	REDBANDED SEABREAM	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00
	JOHN DORY	0,14	0,13	0,13	0,14	0,19	0,15	0,34	0,23	0,21	0,24	0,14	0,19
	RED SCORPION FISH	0,12	0,09	0,12	0,11	0,14	0,12	0,15	0,15	0,12	0,13	0,11	0,11
	AXILLARY SEABREAM	0,25	0,18	0,19	0,12	0,13	0,11	0,12	0,18	0,22	0,16	0,15	0,15
Total LLSH		**1.58**	**1.16**	**1.40**	**1.20**	**1.46**	**1.24**	**1.73**	**1.47**	**1.51**	**1.49**	**1.09**	**1.23**
Trammel Net	EUROPEAN LOBSTER	0,03	0,03	0,03	0,02	0,00	0,00	0,00	0,00	0,02	0,02	0,01	0,01
	SPINOUS SPIDER CRAB	0,14	0,11	0,09	0,07	0,00	0,00	0,00	0,00	0,09	0,09	0,05	0,07
	HORSE MACKEREL	0,20	0,19	0,31	0,14	0,26	0,22	0,34	0,41	0,37	0,39	0,38	0,29
	COMMON SPINY LOBSTER	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,00	0,02	0,01	0,01	0,01
	MULLET	0,11	0,08	0,11	0,04	0,08	0,07	0,07	0,08	0,08	0,11	0,07	0,05
	SOLE	0,08	0,06	0,08	0,05	0,09	0,11	0,09	0,07	0,07	0,06	0,08	0,03
	CUTTLEFISH	0,05	0,03	0,04	0,04	0,06	0,04	0,04	0,06	0,05	0,04	0,04	0,07
	PIPER GURNARD	0,03	0,05	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,01	0,01	0,01
	TURBOT	0,02	0,02	0,01	0,01	0,00	0,02	0,00	0,03	0,01	0,02	0,00	0,01
	JOHN DORY	0,18	0,09	0,16	0,18	0,20	0,15	0,15	0,21	0,24	0,23	0,21	0,23
	RED SCORPION FISH	0,14	0,09	0,12	0,10	0,13	0,13	0,15	0,15	0,13	0,11	0,11	0,14
Total trammel net		**0.99**	**0.76**	**0.98**	**0.70**	**0.85**	**0.75**	**0.85**	**1.03**	**1.12**	**1.08**	**0.98**	**0.93**

The target species were recorded to be mainly caught with gears such as blackspot seabream longline, small hooks longline, large hooks longline, and the trammel net. The Blackspot seabream longline was responsible for the highest CPUE throughout the survey period. The highest value was recorded in September 2018 (8.94 Kg/fishing trip/boat) and the lowest value was recorded in June 2018 (6.40 Kg/fishing trip/boat). Small hooks longline was also used throughout the year, targeting the John Dory, the Europen seabass, the red scorpionfish, and 8 species of Sparidae. The highest CPUE was recorded in December 2018, for the Common seabream with a value of 0.76 Kg/fishing trip/boat, and the lowest CPUE (0.01 kg/fishing trip/boat) was recorded in February 2019 for the black seabream, in October and January for the Gilthead seabream, in April for the European seabass, and in November for the redband seabream. For the large hooks longline, the highest CPUE was recorded for the Mediterranean moray, with a value of 0.22 Kg/ fishing trip/ boat and the lowest (0.01 kg/fishing trip/boat) was determined in January and February 2019 for the Dusky grouper and in April for the dogtooth grouper. The trammel net was also used throughout the year. The highest CPUE was recorded for horse mackerel in January with a value of 0.41 Kg/fishing trip/ boat and the lowest (0.01 kg/fishing trip/boat) was for the European lobster in April and May 2019. for the piper gurnard, it was recorded in March, April, and May, while for the Turbot, the lowest CPUE was in August, September, March, and May, and for the Common spiny lobster, it was assessed in June, July, August, September, March, April, and May. It can be observed that the CPUE was nil for some species at certain periods, which is generally related to the biological rest period of those species and their absence during the catches.

Fig. (8); shows that the monthly CPUE for the blackspot seabream longline is very high compared to the CPUE for small hooks longline, large hooks longline, and the trammel net, whose values are close to each other.

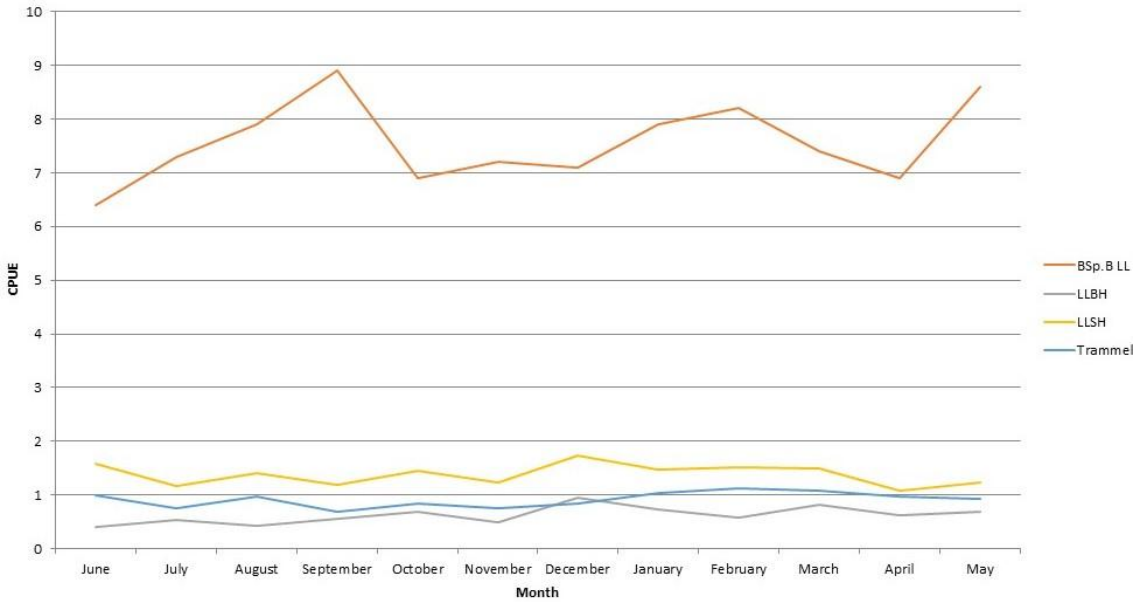


Fig. 8. Monthly CPUE for most used gears

3.4 Species composition and landing

Catches in the projected marine protected area were composed of 31 species of fish, 3 decapod crustaceans, and 2 cephalopod mollusks (Table 8), representing 20 families that belong to 9 orders.

Table 8. Composition of catches in the study area

Taxon	Common Name	Local Name
FISHES		
O/PERCIFORMES		
F/ Sparidae		
Pagellus erythrinus (Linnaeus, 1758)	Common pandora	Lobar
Pagrus pagrus (Linnaeus, 1758)	Common seabream	Paghar
Diplodus cervinus cervinus (Lowe, 1841)	Zebra seambream	Boubradaa
Pagrus caeruleostictus (Valenciennes, 1830)	Bluespotted seabream	Chama
Spondyliosoma cantharus (Linnaeus, 1758)	Black seabream	Zigzag
Diplodus vulgaris (E.Geoffroy St.-Hilaire, 1817)	Common two banded seabream	Chargho
Pagrus auriga (Valenciennes, 1830)	Red banded seabream	Lgara
Pagellus acarne (Risso, 1826)	Axillary seabream	Bjok
Dentex dentex (Linnaeus, 1758)	Common dentex	Denss
Oblada melanura (Linnaeus, 1758)	Saddled seabream	Khila
Boops boops (Linnaeus, 1758)	Bogue	Taghzalt
Pagellus bogaraveo (Brunnich, 1768)	Blackspot seabream	Voracé
F/ Scombridae		
Auxis rochei (Risso, 1810)	Bullet tuna	Melba
Katsuwonus pelamis (Linnaeus, 1758)	Skipjack tuna	Listao
Orcynopsis unicolor (Geoffroy St.-Hilaire, 1817)	Plain bonito	Palomette
Euthynnus alletteratus (Rafinesque, 1810)	Little tunny	Tounina
F/ Serranidae		
Epinephelus caninus (Valenciennes, 1843)	Doogtooth grouper	Badejo/Cherna
Epinephelus marginatus (Lowe, 1833)	Dusky grouper	Mirou
Serranus cabrilla (Linnaeus, 1758)	Comber	Hajila
F/ Carangidae		
Trachurus trachurus (Linnaeus, 1758)	Horse mackerel	Chral
F/ Moronidae		
Dicentrarchus labrax (Linnaeus, 1758)	European seabass	Lhrech/Lep
F/ Haemulidae		
Plectorhynchus mediterraneus (Guichenot, 1850)	Rubberlip grunt	Borriquiti/Chakhar

F/ Mullidae		
Mullus sp.	Mullet	Salmonete
O/ SCORPAENIFORMES		
F/ Scorpaenidae		
Scorpaena scrofa(Linnaeus, 1758)	Red scorpionfish	Gallinita
F/ Triglidae		
Trigla lyra (Linnaeus, 1758)	Piper gurnard	Robio
O/ ANGUILLIFORMES		
F/ Congridae		
Conger conger(Linnaeus, 1758)	European conger	Ghrong
F/ Muraenidae		
Muraena helena (Linnaeus, 1758)	Mediterranean moray	Mrayna
O/ PLEURONECTIFORMES		
F/ Soleidae		
Solea vulgaris vulgaris (Quensel, 1806)	Common sole	Lenguado
F/ Scophthalmidae		
Scophthalmus maximus(Linnaeus, 1758)	Turbot	Rodabalo
O/ ZEIFORMES		
F/ Zeidae		
Zeus faber(Linnaeus, 1758)	John dory	Chatra/Saint pierre
O/ GADIFORMES		
F/ Phycidae		
Phycis phycis(Linnaeus, 1766)	Fork beard	Brotola
DECAPOD CRUSTACEANS		
O/ DECAPODA		
F/ Nephropidae		
Hommarus gammarus(Linnaeus, 1758)	European lobster	Bougavante
F/ Palinuridae		
Palinurus elephas (Fabricius, 1787)	Common spiny lobster	Langouste
F/ MAJIDAE	Spinous spider crab	Santoja/koaaraycha
Maja squinado (Herbst,1788)		
MOLLUSC CEPHALOPODS		
O/ OCTOPODA		
F/ Octpodidae		

Octopus vulgaris (Cuvier, 1797)	Common octopus	Pulpo
O/ SEPIIDA		
F/ Sepiidae		
Sepia officinalis (Linnaeus, 1758)	Common cuttlefish	Sepia/Choco

The catch data were obtained from 14.267 fishing trips, with a total of 160.529 Kg of fish landed. The perciformes represent the most important order with 141.919 Kg, corresponding to 88.4% of the total biomass landed, followed by the zeiformes with a total catch of 5251 Kg, corresponding to 3.3 % of the total biomass landed. The other seven orders contributed together with 8.3 % of the fish landed. Within the perciformes, the sparidae constitute the most important family with 12 species and 90.81 % of the total perciformes catches, corresponding to 128.876 Kg. The most targeted species in the region is the blackspot seabream with 108.053 Kg, which corresponds to 67.3 % of the total fish landed and 83.8 % of the total catch of sparidae. It is worth mentioning that, the composition of the catches varies from site to site and from month to month.

DISCUSSION

Observations revealed that, the artisanal fishery in the marine part of the projected protected area « Jabal Moussa », involved 99 wooden boats in three fishing sites. Two of the three sites (Belyounech and Dalia) were equipped with suitable infrastructures, such as a fish market, an ice factory, a cold room, a mosque, a cafeteria, premises for the fishermen's equipment, a mechanical room, and a room for selling equipments, intended to improve the welfare of fishermen and the value of the product. However, fishermen do not benefit from this infrastructure due to the presence of an informal parallel circuit controlled by fish marketing intermediaries, who frequently intervene in the financing of fishing operations (bait, fishing equipment), making fishermen directly dependent on this unfair intermediary.

The artisanal fishery in the study area has the same characteristics described in many other Mediterranean artisanal fisheries (**Caminas *et al.*, 1991; Farrugio, 1991; Féral, 2001; Malouli Idrissi, 2002; Griffiths *et al.*, 2007; Matic-Skoko *et al.*, 2011; Guyader *et al.*, 2013; FAO, 2015; Najih, 2015; Falautano *et al.*, 2017; Boubekri *et al.*, 2018**). The artisanal fishery is characterized by the use of boats of small-length, small engine power, and small gross tonnage. The fleet in the region has a lifespan ranging from 2 to 37 years with an average lifespan of 10.94 ± 5.91 years. This wide variation is related to the degree of care taken by the boat owner. The results of the Analysis of variance (ANOVA), related to the characteristics of the fleet, showed that the fleet was homogenous in the three sites and that there were no differences among engine power, gross tonnage, and fleet length ($p > 0.05$). Similarly, the results obtained by **Malouli Idrissi (2002)** and **Najih *et al.* (2015)** in the Moroccan Mediterranean (Nador) showed homogeneity in fleet characteristics.

The fishing community is entirely men, with a clear age difference between skippers and seamen. The t-student showed that skippers were older and more experienced than seamen because a seaman must reach certain age and experience to become a skipper. A similar test conducted by **Najih *et al.* (2015)** showed a significant difference between the

means of the two categories as well. However, the high average age of seamen (32.5 ±9.6 years) is still alarming and indicates that the number of unemployed young entering the fishing sector is low, despite the high unemployment rate in the region. The reason for this attitude is not related to economic conditions, but to the difficult conditions of this work and the social perception of the status of artisanal fishermen in the society. The monthly net income per boat in the area, which is proportionally related to the number of crew members, was recorded high due to the target species, especially the blackspot seabream (*Pagellus Bogaraveo*). However, dissatisfaction was detected with respect to the job in general. Nevertheless, it was remarkable that artisanal fishing represents an important source of income for the fishermen and their families, and plays an important economic role.

As the profession does not require a high level of education and that the experience is generally acquired through working or passed down from generation to the other, most fishermen were noted to be illiterate or dropped out of school, considering this profession as a last resort. As a result, the low level of education of fishermen hinders the modernization of the sector because they are content with what has been passed down to them and are not willing to develop the techniques they use or to introduce new ones.

However, artisanal fishing still plays a very important cultural role and contributes to the perpetuation of traditions and their transmission, as has been demonstrated in other Mediterranean regions (**Farrugio *et al.*, 1993; Gómez *et al.*, 2006; Guidetti, 2012**). Thus, the department of maritime fisheries in collaboration with local cooperatives and the Institute of Fisheries technology in Larache must imperatively think about planning specialized training for the benefit of fishermen to enable them to develop their capabilities and get them out of the precariousness in which they currently live. On the social level, the social security coverage enjoyed by all fishermen has allowed them and their families to have access to various public and private health services.

Other Mediterranean studies (**Farrugio *et al.*, 1993; Falautano *et al.*, 2017**) described the artisanal fishery in the study area as multispecific, targeting a wide range of resources, particularly high value species. It was noticed that, catch composition and yield varied from site to site and month to month depending on the number of fishing trips, gears used, weather, religious festivities, lack of bait and technical problems related to both the engine and the boat. Thus, there are periods of high activity (June-July, September, March-April) and periods of low activity (August, October to February). The duration of the fishing trips was recorded to be relatively low and depended directly on the fishing technique and the fishing ground. It did not exceed 24 hours. The time required to reach the fishing ground from the fishing site varied between 30 minutes and one hour. This is in perfect agreement with the results of studies conducted by **Matic-Skoko *et al.* (2011)** and **Guyader *et al.* (2013)**, which also showed that artisanal fishing trips rarely exceeded one day and usually lasted only a few hours. Once back at the fishing site, fishermen should repair damaged gears and prepare for the next fishing trip.

The analysis of CPUE values according to the fishing gears used showed that the blackspot seabream longline was responsible for the highest values obtained in the results. The species with the highest CPUE were the most targeted. The study of this parameter in a single year was not sufficient to estimate the real state of exploitation of the stock, but if the high CPUE found for this species was combined with the information collected from the

fishermen, who complained about the drastic reduction of catches, it can be concluded that special attention should be paid to this species, so that a revision of the commercial size and a biological rest period can be proposed. The CPUE of the other species was very low, so the improvement of existing fishing techniques and the introduction of new selective methods would undoubtedly increase the quantities landed of the less exploited species. This would reduce the pressure on the blackspot seabream. At certain times of the year, it was observed that the CPUE was zero, which is generally related to periods of biological rest for species such as *Epinephelus caninus*, *Epinephelus marginatus*, *Hommarus gammarus*, *Palinurus elephas*, *Maja squinado*, and to the ecology and dynamics of the resources.

Similar to many other Mediterranean studies (**Battaglia *et al.*, 2010; Di Franco, 2014; Falautano *et al.*, 2017**), the artisanal fishery in the study area is heterogeneous and uses 8 fishing techniques, which were not always present in the three sites. It is mostly related to the know-how transmitted from generation to generation and also to the topography of the area. Studies that have focused on the fishing gears used by the artisanal fishery in the Mediterranean have shown that gillnets and trammel nets were the most used gears (**Battaglia *et al.*, 2010; Matic-Skoko *et al.*, 2011; Rodriguez-Rodriguez, 2014**). In the current case, the most used gear was the blackspot seabream longline, which was a very selective gear targeting only the blackspot seabream. This distinction from other Mediterranean fisheries is due to the abundance of this species in the waters of the Strait of Gibraltar, both on the Moroccan and Spanish coasts. According to the surveys carried out among the fishermen, this is a fishery that started in the 1950s and has developed strongly since the 1980s. On the Spanish coasts, this fishery started to appear in the mid-1970s by some boats from Ceuta, although its expansion started in 1983 (**García Del Hoyo *et al.*, 2001**).

The invested capital of a value of 4.680.800 MAD could be increased if the intervention of the competent authorities to reassure the profession on the future of the activity was more effective. Past experiences have shown convincing results, as was the case with the IBHAR program to modernize the fleet. During 2018, an insurance system covering fishermen and means of production was set up by the Department of Maritime Fisheries in Rabat, and would undoubtedly encourage fishermen to invest more in the acquisition of new and more sophisticated means of production. However, the adherence of artisanal fishermen to this type of initiative remains essential to the development of this sector, and thus, contributes to the increase of this key indicator of the artisanal fishing sector in the region. Generally, the acquisition of these means of production is done through personal savings, however, other means of financing exist but to a lesser extent such as family mutual aid. Some fishermen claim that they have not had the right to bank credit because of a lack of guarantees for repayment. In this case, the state should consider helping local cooperatives (including agriculture and forestry cooperatives) to create their financial institutions based on the monthly contribution system and to grant loans. The Japanese experience in this regard should be taken as a model (**Norinchukin bank, 2017**).

The gross product of the region was obtained by multiplying the quantities of fish caught in the region by the average prices of the different species. It was estimated at 22.185.246 MAD. This is a huge sum which shows that the fishermen have made a fairly significant effort and that this sector is an economic resource despite its precariousness and lack of interest. This indicator shows that this sector could be more productive if there were a

common awareness and collaboration based on the top-down, bottom-up system between the professionals and the competent authorities.

CONCLUSION

Artisanal fishery is an important economic activity in the region. It provides high net incomes due to the high commercial value of the targeted species. It has contributed to the direct and indirect employment for a large part of the population and is a key role in maintaining the socio-economic balance of the fishing sites of Belyounech, Oued El Marsa, and Dalia. However, the high illiteracy rate, the limited number of training courses and the lack of innovation of fishermen are all factors that threaten the sustainable development of the sector.

Despite the important economic role played by artisanal fishery in the region, the new generations are no longer attracted to the fishing activity. Additional efforts need to be made by the authorities to develop the sector and make it more attractive to these people. This study will be completed by the creation of maps, through GIS, with the fishing grounds of the blackspot seabream and other exploited species within the projected marine area. This will help the managers of the future MPA to adopt direct measures that can reduce the pressure on this valuable species and redirect the effort towards the least exploited species, provided that this effort will be continuously monitored. The establishment of the MPA in the region must be accompanied by alternative and parallel activities, such as onshore enhancement structures for species with low commercial value and activities such as aquaculture, diving, pescatourism, and whale-watching.

REFERENCES

Arculeo, M. and Riggio, S. (1983). Dati preliminari sulla piccola pesca nel Golfo did Palermo. *Nova Thalassia*, *6*(Suppl.), 725pp.

Ardizzone, G.D. (1985). Analysis of the fisheries of the central Tyrrhenian Sea.FAO Fish.Rep. 362: 51-60.

Battaglia, P.; Romeo, T.; Consoli, P.; Scotti, G. and Andaloro, F. (2010). Characterization of the artisanal fishery and its socio-economic aspects in the central Mediterranean Sea (Aeolian Islands, Italy).*Fisheries Research*, *102*(1-2): 87-97.

Boubekri, I.; Caveen, A. J.; Djebar, A. B.; Amara, R. and Mazurek, H. (2018). Structure and spatio-temporal dynamics of the artisanal small-scale fisheries at the future MPA of "Taza" (Algerian coast, SW Mediterranean). Mediterranean Marine Science, 19(3): 555-571.

Caminas, J. A.; Lleonart, J.; Mas, J. and Oliver, P. (1991). Considérations méthodologiques sur la pêche aux petits métiers dans la Méditerranée espagnole.

Colloca, F.; Crespi, V.; Cerasi, S. and Coppola, S. R. (2004). Structure and evolution of the artisanal fishery in a southern Italian coastal area.*Fisheries Research*, *69*(3): 359-369.

Coppola, S. R. (2006). Inventory of artisanal fishery communities in the Central and Western Mediterranean (Vol. 77). Food & Agriculture Organization

De Metrio, G.; Bello, G.; Lenti, M.; Petrosino, G. and Sciscioli, V. (1985). L'attività di pesca col tramaglio di fondo della marineria di Porto Cesareo (Le) negli anni 1978–1983. Nota I. *Oebalia*, *2*: 593-607.

Di Franco, A.; Bodilis, P.; Piante, C.; Di Carlo, G.; Thiriet, P.; Francour, P. and Guidetti, P. (2014). Fishermen engagement, a key element to the success of artisanal fisheries management in Mediterranean marine protected areas. MedPAN North Project. WWF-France, Paris, France.

Diaw M.C. (1989). Partage et appropriation : les systèmes de parts et la gestion des unités de pêche. In : Verdeaux François (ed.). La pêche : enjeux de développement et objet de recherche : 1. Paradigme halieutique : l'indispensable rationalisation de l'exploitation d'une ressource vivante, renouvelable et non appropriée. Cahiers des Sciences Humaines, 25 (1-2) : 67-87. ISSN 0768-9829

Falautano, M. ; Castriota, L. ; Cillari, T. ; Vivona, P. ; Finoia, M.G. and et al. (2018). Characterization of artisanal fishery in a coastal area of the Strait of Sicily (Mediterranean Sea): Evaluation of legal and IUU fishing. Ocean & Coastal Management, 151: 77-91.

FAO. (2005). Fisheries and Aquaculture topics.Small-scale and artisanal fisheries. Key features of small-scale and artisanal fishing. In: FAO- Fisheries and *aquaculture department, Rome*

FAO. (2016a). Directives volontaires visant à assurer la durabilité de la pêche artisanale dans le contexte de la sécurité alimentaire et de l'éradication de la pauvreté. Food and Agriculture Organization (FAO), 17 pp.

Farrugio, H.; Olliver P.; Biagi F. (1993). An overview of the history, knowledge, recent and future research trends in Mediterranean fisheries. *Sci. Mar.*, 57: 105-119.

Farrugio, H. (1991). Artisanat et pêche en Méditerranée: évolution et état de la recherche. La recherche scientifique face à la pêche artisanale= Research and small-scale fisheries. ORSTOM, Paris (France), 143-156.

Féral, F. (2001). Sociétés maritimes, droits et institutions des pêches en Méditerranée occidentale. Revue synthétique des droits collectifs et des systèmes décentralisés de

discipline WWF page 121 professionnelle. FAO Document technique sur les pêches, 420: 1-62.

Garcıa, J. J. ; Garcıa, F. ; González, M. D. ; and Vılchez, M. L. (2001). Polıticas de gestión de pesquerıas artesanales. Servicio de Publicaciones de la Universidad de Huelva, Huelva.

García-Rodríguez, M.; Fernández, Á. M.; and Esteban, A. (2006). Characterization, analysis and catch rates of the small-scale fisheries of the Alicante Gulf (SE Spain) over a 10 years' time series. *Fisheries Research*, *77*(2): 226-238.

Gómez, S.; Lloret, J.; Demestre, M.; and Riera, V. (2006). The decline of the artisanal fisheries in Mediterranean coastal areas: the case of Cap de Creus (Cape Creus). *Coastal Management*, *34*(2): 217-232.

Griffiths, R.C.; Robles, R.; Coppola, S.R. and et al. (2007). Is there a future for artisanal fisheries in the western Mediterranean? FAO. Rome.

Guidetti, P. (2012). The multiple aspects of artisanal fishing in the Mediterranean.In *Final conclusions of the Meeting of Artisan fishermen and Marine Protected Areas of the Mediterranean.*PianteC. (Ed.) *MedPAN North Project. WWF, France*: 23 pp

Guidetti, P.; Bussotti, S.; Pizzolante, F. and Ciccolella, A. (2010). Assessing the potential of an artisanal fishing co-management in the Marine Protected Area of Torre Guaceto (southern Adriatic Sea, SE Italy).*Fisheries Research*, *101*(3): 180-187.

Gunarso, W. and Wiyono, E.S. (1994). Studi Tentang Pengaruh Perubahan Pola Musim dan Teknologi Penangkapan Ikan Terhadap Hasil Tangkapan Ikan Layang (Decapterus sp) di Perairan Laut Jawa. Buletin ITK Marite.Vol. 4. No. 1. Fakultas Perikanan. Institut Pertanian Bogor, pp. 55-58.

Guyader, O.; Berthou, P.; Koutsikopoulos, C. and et al. (2013). Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fisheries research, 140: 1-13.

IUCN. (2012). Marine Mammals and Sea Turtles of the Mediterranean and Black Seas. Gland, Switzerland and Malaga, Spain: IUCN. 32 pp.

Jabeur, C. ; Gobert, B. ; Missaoui, H. (2000). Typologie de la flottille de pêche côtière dans le golfe de Gabès (Tunisie). Aquatic Living Resources, 13 (6):421-428.

Malouli, I. M.; Zahri, Y.; Houssa, R.; Abdelaoui, B. and El Ouamari, N. (2002). Pêche artisanale dans la lagune de Nador: Exploitation et aspects socio-économiques. Retrived

from http://webco. faocopemed. Org/old_ copemed/vldocs/0000762/case_std_nador. pdf.

Marshall E. and Brossier, J. (1981). Le raisonnement économique des décisions de l'agriculteur, INRA

Najih, M.; Berday, N.; Lamrini, A.; Nachite, D. and Zahri, Y. (2015). Situation de la pêche aux petits métiers après l'ouverture du nouveau chenal dans la lagune de Nador. Revue Marocaine des Sciences Agronomiques et Vétérinaires, 3(1) : 19-30.

Matić-Skoko S.; Stagličić N.; Pallaoro A.; Kraljević M.; Dulčić J.; Tutman P.; Dragičević B. (2011). Effectiveness of conventional management in Mediterranean-type artisanal fisheries. Est.coast. Shelf Sci., 91: 314-324.

Maynou, F.; Morales-Nin, B.; Cabanellas-Reboredo, M.; Palmer, M.; García, E. and et al. (2013). Small-scale fishery in the Balearic Islands (W Mediterranean): A socio-economic approach. Fisheries Research, 139: 11-17.

Merino, G.; Karlou-Riga, C.; Anastopoulou, I.; Maynou, F.; Lleonart, J. (2007). Bioeconomic simulation analysis of hake and red mullet fisheries in the Gulf of Saronikos (Greece). Sci. Mar. 71: 525–535.

Merino, G.; Morales-Nin, B.; Maynou, F.; Grau, A.M. (2008). Assessment and bio-economic analysis of the Majorca (NW Mediterranean) trammel net fishery. Aquatic Living Resources, 21 (2): 99-107.

Norinchukin bank. (2017). https://www.nochubank.or.jp/en/

Perez-Gimeno, N.; De Stephanis, R.; Salazar-Sierra, J. M.; Verborgh, P.; Cañadas, A. and Guinet, C. (2004). Do bottlenose dolphins (Tursiops truncatus) show any seasonal pattern in the Strait of Gibraltar? European Research on cetaceans, 18.

Pinello, D. and Dimech, M. (2013). Socio-economic analysis of the Lebanese fishing fleet.*EastMed Technical Documents (FAO).*

Piniella, F.; Soriguer, M.; Fernández-Engo,M.A. (2007). Artisanal fishing in Andalusia: a statistical study of the fleet. Mar. Pol. 31 : 573–581.

PNUE/PAM-CAR/ASP. (2016). Maroc : Site de Jbel Moussa.Cartographie des habitats marins clés de Méditerranée et initiation de réseaux de surveillance. Par Bazairi H., Sghaier Y.R., Benhoussa A., Boutahar L., El Kamcha R., Selfati M., Gerovasileiou V., Baeza J., Castañer V., Martin J., Valriberas E., González R., Maestre M., Espinosa F.& Ouerghi A. Ed. CAR/ASP - Projet MedKeyHabitats, Tunis. 92 p + Annexes.

Ramos-Esplá A.A. ; Valle-Pérez C. ; Bayle-Sempere J.T ; Sánchez-Lizaso J.L. (2004). Zone Marines Protégées comme outil de gestion de pêche en Méditerranée (Zone COPEMED). Série rapports et études COPEMED n°11.

Reglero, P. and Morales-Nin, B. (2008). Relationship between first sale price, body size, and total catch of trammel net target species in Majorca (NW Mediterranean). *Fisheries research*, *92*(1): 102-106.

Rodríguez-Rodríguez, D. (2014). Artisanal Fisheries in the Mediterranean.MedPAN, Marseille, France.

Stergiou,K.I.;Moutopoulos,D.K.; Soriguer,M.C.; Puente,E.; Lino,P.G.; Zabala,C.; Monteiro, P.; Errazkin, L.A.; Erzini, K. (2006). Trammel net catch species composition, catch rates and metiers in southern European waters: a multivariate approach. Fish. Res. 79 (1–2): 170–182.

Tzanatos, E.; Dimitriou, E.; Katselis, G.; Georgiadis, M.; Koutsikopoulos, C. (2005). Composition, temporal dynamics, and regional characteristics of small-scalefisheries in Greece.Fish. Res. 73 (1–2): 147–158.

Tzanatos, E., Dimitriou, E., Papaharisis, L., Roussi, A., Somarakis, S., Koutsikopoulos, C., (2006). Principal socio-economic characteristics of the Greek small-scale coastal fishermen.Ocean Coast.Manag. 49: 511–527.

Whitmarsh, D.; Pipitone, C.; Badalamenti, F.; D'Anna, G. (2003). The economic sustainability of artisanal fisheries: the case of the trawl ban in the Gulf of Castellammare, NW Sicily. Mar. Pol. 27: 489