



The coastal fleet of the Moroccan Mediterranean: the sea of Al Hoceima as a case study

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ABSTRACT

The port of Al Hoceima is located on the Mediterranean coast about 150 km west of Nador city, the western extremity of Al-Hoceima Bay, and is the only Mediterranean gateway in the North-Central region. The port of Al Hoceima is characterized by coastal and artisanal fishing. The objectives of this study were the knowledge of the main fleets that exist in the Al Hoceima region, to identify the different fishing gears used and to inventory, the fishing resources caught and landed in the port of Al Hoceima. A detailed survey (concerning the fishing vessels and their characteristics related to the fishing method and the landed catches) was used and analyzed during the period between Avril and September 2020 in the port of Al Hoceima. The results showed the existence of three types of coastal fleets. The benthic trawlers (15 units), the longliners (16 units), and the purse seiners (14 units). The catches of the fleets were depending on the target species and characterized by different types of species and also by those groups with a very high market value.

INTRODUCTION

In the Mediterranean Sea, the coastal fishery is essentially a traditional and small-scale activity, referred to multispecies and multifleet, or mixed, fisheries (Alarcón, 2001; Colloca *et al.* 2004; Tzanatos *et al.* 2006). The fleet, operates mainly on the continental shelf (0-200 m depth), in zones that can be reached in a few hours from ports (Farrugio and Le Corre, 1993; Colloca *et al.*, 2004; Tzanatos *et al.*, 2005, 2006; Duarte *et al.*, 2009; Forcada *et al.*, 2010; Maynou *et al.*, 2011). Ships in a given fleet segment may adopt different fishing practices depending on the captain, market conditions, or tradition. However, for a given target species, the gear used and the fishing location may also change according to the seasonal dynamics of the resources (Colloca *et al.*, 2004; Tzanatos *et al.* 2006; Forcada *et al.*, 2010).

In Morocco (North Africa), Coastal fishing has developed remarkably over the last few decades (Ayouché, 2002). The operational coastal fishing fleet was composed of 1755 units, with an overall capacity of 108419 GRT (gross register tonnage) (Doukkali and Kamili, 2018). This fleet is composed of boats from 10 to 25 meters in length, distributed mainly among purse seiners (39%), trawlers (36%) and longliners (25%) (DPM, 2016). The most coastal fishing gears used are longlines, trawls and purse seines, amounting to 267 boats in 2007 (Benhardouze, 2009).

In the Moroccan Mediterranean coast, studies focusing on the characterization of fishing gear and the description of the coastal fleet are missing and almost absent (Darasi and Aksissou, 2019). Indeed, at Al Hoceima level (Alboran Sea), the coastal fleet is very diversified regarding fishing gear as well as the types of boats (Malouli, 2004), however, the fleet's description of the species landed is still lacking.

In order to achieve a better management of fisheries resources in the Al Hoceima area, this paper will focus on the description of the coastal fleet fishing as well as the identification of fishing landings in the port of Al Hoceima.

MATERIAL AND METHODS

1. Study area

The port of Al Hoceima is located in northern Morocco, on its Mediterranean coast, about 150 km east of the Strait of Gibraltar and is limited to the west by the National Park of Al Hoceima. (Fig.1)

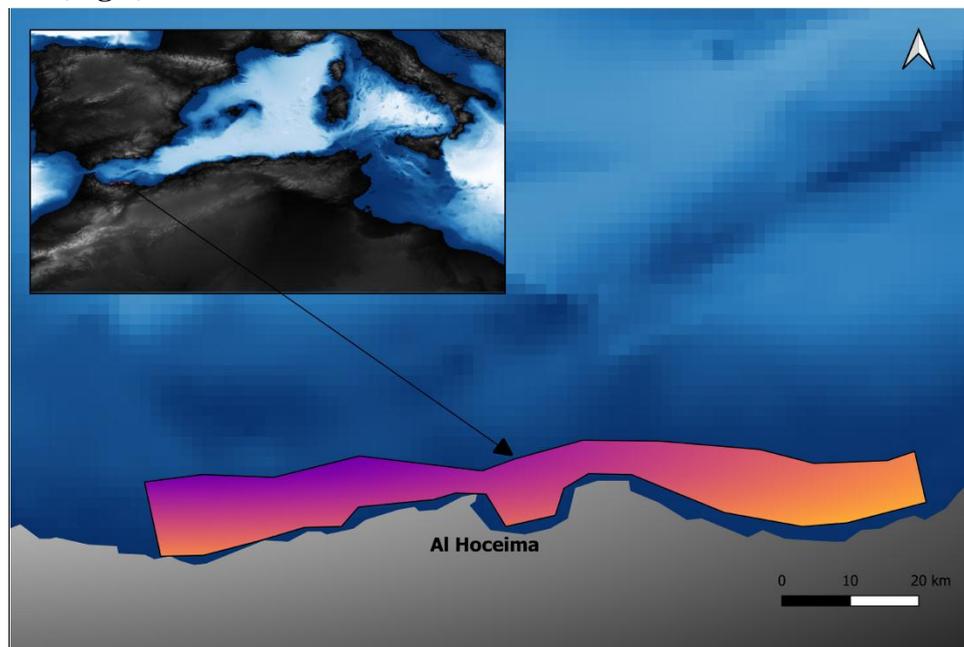


Figure 01: Location of Al Hoceima

2. Data collection

In the present study, data inputs were collected from four main sources: 1) Data of the National Fisheries Office to determine the types of fleet-boat and the main fishery resources landed in the port; 2) Data related to the Moroccan Maritime Fisheries Department, to obtain

the characteristics of the equipment and fishing techniques used in the coastal fleet; 3) Data obtained from the professionals (fishermen, captains and/or boat owners) in the port of Al Hoceima, using a detailed questionnaire (on the gear used, number of fishermen, target species, number of trip/month and fishing area...); 4) Observation data on board (18 observations: 5 on trawlers, 10 on purse seiners and 3 on longliners) to confirm the commercial species landed in port and to determine the species not targeted by the fleet.

RESULTS AND DISCUSSION

1. The coastal fishing fleet

Data analysis showed the existence of three types of coastal fishing fleet in the port of Al Hoceima (14 seiners, 15 trawlers, 16 longliners) (**Fig. 2**). Trawlers and longliners operate in the area between Nador and Jebha according to the favorable fishing areas or chosen by the skippers, whereas for the purse seiners, most of the boats operate in the Bay of Al Hoceima (Observations on board). The number of trips depends on the sea conditions, trawlers are able to fish in light-to-moderate seas with a monthly trip rate of 15 ± 1.73 and each trip takes between 1 to 3 days. For the longliners and purse seiners, the rate was 15 ± 2.82 and 25 ± 1.46 respectively. . purse seiners fish two times/day and rarely the trip exceeds one day. On the other hand, longliners can spend more than three days out on the sea in favorable conditions.

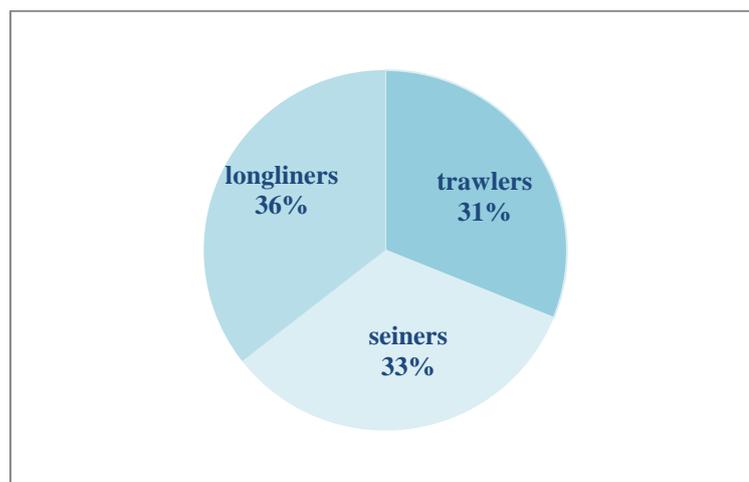


Figure 2: Composition of the fleet in the port of Al Hoceima

1.1. The seiners

The number of seiners registered at the port of Al Hoceima during the year 2015 is 29 boats (**DPM, 2015**). During this study, only 14 seiners are still registered at the port, out of which 4 vessels were operating in the port of Al Hoceima, the rest have immigrated to the ports of the Atlantic coast (**DPM, 2020**). This decline in the number of boats is caused by the loss of fishing gears due to their damage by the bottlenose dolphins (**Zahri et al, 2004**).

Seiners or sardine boats are characterized by an ellipsoidal shape of an average of 54.43 GRT and an average length of 19.30m. The average engine power is about 360.82 HP (horsepower) (**Table 1**). using a net called the purse seine which consists essentially of a long

sheet made up of a series of panels of different meshes with floats on its upper edge and ballast and rings attached to its lower edge. The panel of the smallest mesh and thickest wire, usually located at one end of the net, forms the “pocket” in which the catch is grouped. The net does not exceed 600 m in length and 30 m in height.

Table 1: Technical Characteristics of Seiners

Technical characteristics	LHT	LARG	GRT	Power(HP)
Max	23.50	16.00	78.40	600.00
Average	19.30	6.45	54.43	360.82
Min	7.75	2.75	4.22	90.00

Purse seine technique

The fishing gear used by the fleet is the purse seine, consisting of nets with a mesh size of 9 and/or 11 mm. The dimensions of the gear differ, depending on the gross tonnage of the vessel and/or the depth of the fishing zone. Generally, the length varies between 300-650 m, and the width between 50-160 m. According to **Roullot *et al.* (1984)**, the theoretical fall at work for this gear is between 32-70 m.

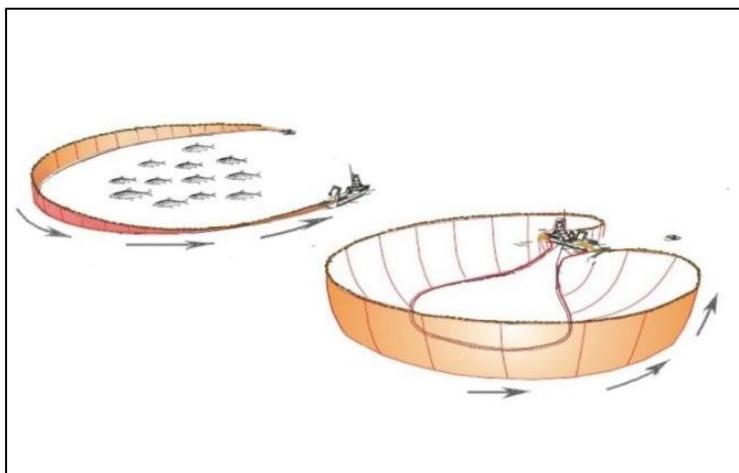


Figure 3: The spinning and sliding of the seine

Fishing operations are carried out in most cases during the night, by operating with the depth sounder to detect the shoal of fish, the light boat to group the shoal, and a rowboat to help maintain the proper shape of the seine during the fishing operation (**Assabir, 1985**).

The fish are caught at the end of the fishing operation by closing the lower part of the net with a cable sliding through the rings of the seine (**Fig. 3**). The catch is then concentrated in the "pocket" by gradually pulling the net onboard the boat, then loaded on board employing a large brailer. The first stages of the fishing operation do not last more than 20 minutes, the hauling phase of the net and recovery of the catch normally take more than one hour.

1.2. Longline

The number of longliners registered at the port of Al Hoceima is 16. They are usually small boats, characterized by an average length of 9.87 m, an average of 7.77 GRT and an average engine power of 85.11 HP.

Handline and longline fishing generally consist of a main line (master line) on which are mounted series of hooks using short lines (forward), these are distributed on the mother

line at regular intervals and sufficiently spaced to avoid entanglement during spinning (**Baddy and Guénette, 2001**). Longliners are generally divided into two categories (**Echwiki, 2011**):

- **Bottom longlines:** Exploited in Al Hoceima riding in the sandy and rocky nature bottom to target bottom species such as the sea bream and conger (**Table 5**) reaching 7 to 8 km long and supporting about 1500 to 2000 small hooks (**Benhardouze, 2009**).
- **Surface longlines:**

Three main types of surface longliners are used in Al Hoceima constituency: swordfish longline, longline, and tuna longline (**Doumenge, 1998; Matsuda, 1998**). They are characterized by sequences of small numbers of advance, spaced by buoys to keep them on the surface. Of great length (2 to 4 km), these 3 types of longlines differ in size and depth of immersion of their hooks. The bait attached to the hook is selected based on the target species but also its availability, resistance and cost (**Beverly et al., 2003**).

Table 2: Technical characteristics of longliners

Technical characteristics	LHT	LARG	GRT	Power(HP)
Max	12.90	4.55	17.98	160.00
Average	9.87	3.17	7.77	85.11
Min	7.60	2.50	2.89	31.00

1.3. Trawlers

A trawler is a trawl-equipped vessel with an average length of 18.38 m. They have a minimum power of 80 HP (**Table 3**). Most trawlers in Al Hoceima port are built of wood (**DPM, 2019**).

The bottom trawl is a conical net towed by a vessel (**Bjordan, 2002**). It is connected to the ship by steel ropes called warps, their length determined according to the depth of the fishing route (3 times the depth). Diverging wooden panels located at the front of the trawl ensure a good horizontal opening.

The vertical opening of the trawl is provided by floats attached to its upper lifeline, called headline. The bottom of the trawl is kept in contact with the bottom by a bulge attached to the front of the bottom. This bulge is of variable shape and weight according to the nature of the background. The trawl speed between 2 and 4 knots, depending on the vessel's search species and capabilities. (**Fig. 4**)

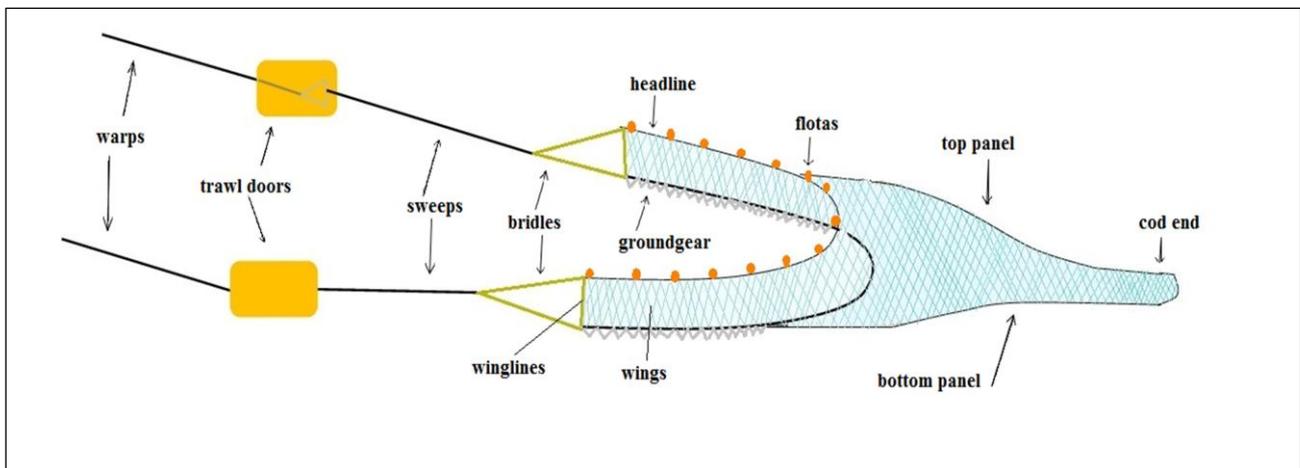


Figure 4: Standard otter trawl design of bottom trawl

In the port of Al Hoceima there are two great trawl families:

- Trawls with a low vertical opening, less than 2 meters, suitable for catching live animals very close to the bottom or slightly peeled off, such as flatfish, mud mullet, and shrimp. Most of the Mediterranean bottom trawls belong to this type, like the «tartana» Italian, the Spanish «vuelvano» or the «tangonero» with very long wings.
- Trawlers with a large vertical opening, greater than 5 meters. These trawls, sometimes referred to as «semi-pelagic» trawls, are used mainly for the capture of demersal species taken off from the bottom.

Table 3: The technical characteristics of trawlers

Technical characteristics	LHT	LARG	GRT	Power(HP)
Max	22.96	7.74	69.85	500.00
Average	18.38	5.74	43.77	327.75
Min	12.25	4.40	15.23	80.00

2. The crew

Fishing activity in Al Hoceima region generates direct employment of about 617 fishermen, of whom almost 51 % work on seiners. The distribution by fleet type is shown in the Table 4.

Table 4: Crew of each category of inshore fisheries

	Seiner	Longliner	Trawler	Total
Min	18	2	9	
Average	26	6	14	
Max	38	8	19	
Total	315	97	205	617

The maritime population is purely male, with exceptional cases of female trainees from the Al Hoceima Institute of Marine Fisheries Technology, the fishing community is relatively young with an average age of 38. The age of fishermen varies between 20 and 60 years. For schooling, the majority of sailors have a low level of schooling (Koranic and/or primary studies). Rare those who were able to reach a university level (less than 10% of the total population).

The attacks of bottlenose dolphins on purse seines cause serious damage to purse seiners, which cause almost all of them to change the port of activity of their units. This fleet migration has a negative impact on the socio-economic situation of a large number of local fishermen making up the crew of the seiners in question. The number of fishermen working in Al Hoceima in 2005 is 2100 fisherman by the coastal fleet (DPM, 2005), fishermen working with a difference of 617 (DPM, 2020).

Table 5: the composition of landings by fleet

Families/Species	Trawl	Seine nets	longline
Fish			
Anguillidae			
<i>Anguilla anguilla</i> (Linnaeus, 1758)	+		+
Argentinidae			
<i>Argentina sphyraena</i> (Linnaeus, 1758)	+		
Bramidae			
<i>Brama brama</i> (Bonnaterre, 1788)	+		
Belonidae			
<i>Belone belone</i> (Linnaeus, 1761)	+		
Carangidae			
<i>Campogramma glaycos</i> (Lacepede, 1801)	+	+	+
<i>Lichia amia</i> (Linnaeus, 1758)	+	+	+
<i>Trachinotus ovatus</i> (Linnaeus, 1758)	+	+	+
<i>Trachurus trachurus</i> (Linnaeus, 1758)	+	+	
Congridae			
<i>Conger conger</i> (Linnaeus, 1758)	+		+
Cepolidae			
<i>Cepola macrophthalma</i> (Linnaeus, 1758)	+		
Clupeidae			
<i>Sardina pilchardus</i> (Walbaum, 1792)		+	
<i>Sardinella maderensis</i> (Lowe 1838)		+	
<i>Sardinella aurita</i> (Valenciennes, 1847)		+	
Caproides			
<i>Capros aper</i> (Linnaeus, 1758)	+		
Engraulidae			
<i>Engraulis encrasicolus</i> (Linnaeus, 1758)	+	+	
Gadidae			
<i>Phycis phycis</i> (Linnaeus, 1766)	+	+	
<i>Micromesistius poutassou</i> (Risso, 1826)	+		
<i>Trisopterus capelanus</i> (Lacepede 1800)	+		
Gobiidae			
<i>Gobius niger</i> (Linnaeus, 1758)	+		
Haemulidae			
<i>Pomadasys incisus</i> (Bowdich 1825)	+		
Lophiidae			
<i>Lophius budegassa</i> (Spinola, 1807)	+		
<i>Lophius piscatorius</i> (Linnaeus, 1758)	+		
Merlucciidae			
<i>Merluccius merluccius</i> (Linnaeus, 1758)	+	+	+
Moronidae			
<i>Dicentrarchus labrax</i> (Linnaeus, 1758)	+		
<i>Dicentrarchus punctatus</i> (Bloch 1792)	+	+	
<i>Muraena helena</i> (Linnaeus, 1758)	+		
Mullidae			
<i>Mullus barbatus</i> (Linnaeus, 1758)	+	+	
<i>Mullus surmuletus</i> (Linnaeus, 1758)	+		+
Mugilidae			
<i>Chelon labrosus</i> (Risso, 1827)	+		
<i>Liza ramada</i> (Risso 1810)	+		
Macroramphosidae			
<i>Macroramphosus scolopax</i> (Linnaeus, 1758)	+		+
Pomatomidae			
<i>Pomatomus saltatrix</i> (Linnaeus, 1766)		+	
Sciaenidae			
<i>Argyrosomus regius</i> (Asso, 1801)			+

<i>Umbrina canariensis</i> (Valenciennes, 1843)	+		+
<i>Umbrina cirrosa</i> (Linnaeus, 1758)	+		+
<i>Umbrina ronchus</i> (Valenciennes, 1843)	+		+
Serranidae			
<i>Epinephelus caninus</i> (Valenciennes, 1843)	+		
<i>Serranus cabrilla</i> (Linnaeus, 1758)	+		
Sparidae			
<i>Diplodus cervinus cervinus</i> (Lowe, 1838)	+		
<i>Sarpa salpa</i> (Linnaeus, 1758)		+	
<i>Diplodus sargus</i> (Linnaeus, 1758)	+	+	
<i>Sparus auratus</i> (Linnaeus, 1758)	+		+
<i>Boops boops</i> (Linnaeus, 1758)	+	+	
<i>Dentex dentex</i> (Linnaeus, 1758)	+		+
<i>Dentex gibbosus</i> (Rafinesque, 1810)	+		
<i>Dentex macrophthalmus</i> (Bloch 1791)	+		+
<i>Diplodus cervinus</i> (Lowe 1838)	+		+
<i>Oblada melanura</i> (Linnaeus, 1758)	+		
<i>Pagellus acarne</i> (Risso, 1827)	+	+	+
<i>Pagellus bogaraveo</i> (Brunnich, 1768)	+		+
<i>Pagellus erythrinus</i> (Linnaeus, 1758)	+	+	
<i>Pagrus pagrus</i> (Linnaeus, 1758)	+		
<i>Sparus aurata</i> (Linnaeus, 1758)	+		+
<i>Spondylisoma cantharus</i> (Linnaeus, 1758)	+		+
Trachinidae			
<i>Trachinus draco</i> (Linnaeus, 1758)	+	+	
<i>Trichiurus lepturus</i> (Linnaeus, 1758)	+		+
Trachichthyidae			
<i>Hoplostethus mediterraneus</i> (Cuvier, 1829)	+		
Xiphiidae			
<i>Xiphias gladius</i> (Linnaeus, 1758)			+
Citharidae			
<i>Citharus linguatula</i> (Linnaeus, 1758)	+	+	
Scophthalmidae			
<i>Lepidorhombus whiffiagonis</i> (Walbaum, 1792)	+		+
Soleidae			
<i>Dicologlossa cuneata</i> (Moreau, 1881)	+		+
<i>Microchirus variegatus</i> (Donovan, 1808)	+		+
<i>Pegusa lascaris</i> (Risso, 1810)	+		+
<i>Solea senegalensis</i> (Kaup, 1858)	+		+
<i>Solea vulgaris</i> (Linnaeus, 1758)	+		+
Scorpaenidae			
<i>Scorpaena porcus</i> (Linnaeus, 1758)	+		+
<i>Scorpaena elongata</i> (Cadenat, 1943)	+		
Scombridae			
<i>Auxis thazard thazard</i> (Lacepede 1800)	+		+
<i>Euthynnus alletteratus</i> (Rafinesque, 1810)	+	+	+
<i>Katsuwonus pelamis</i> (Linnaeus, 1758)		+	+
<i>Scomber japonicus</i> (Houttuyn, 1782)	+	+	+
<i>Scomber scombrus</i> (Linnaeus, 1758)	+	+	+
<i>Thunnus alalunga</i> (Bonnaterre, 1788)	+	+	+
<i>Thunnus albacares</i> (Bonnaterre, 1788)	+		+
<i>Thunnus thynnus</i> (Linnaeus, 1758)	+		+
Zeidae			
<i>Zeus faber</i> (Linnaeus, 1758)	+		
Cartilaginous fish			
Carcharhinidae			
<i>Carcharhinus leucas</i> (Valenciennes, 1841)	+		+
Scyliorhinidae			

<i>Scyliorhinus canicula</i> (Linnaeus, 1758)	+	+
Centrophoridae		
<i>Squalus uyato</i> (Rafinesque, 1810)	+	+
Triglidae		
<i>Aspitrigla cuculus</i> (Linnaeus, 1758)	+	
<i>Trigla lyra</i> (Linnaeus, 1758)	+	
<i>Peristedion cataphractum</i> (Linnaeus, 1758)	+	
Rajidae		
<i>Leucoraja naevus</i> (Müller & Henle, 1841)	+	+
Cephalopods		
Octopodidae		
<i>Octopus vulgaris</i> (Cuvier, 1797)	+	
Sepiidae		
<i>Sepia officinalis</i> (Linnaeus, 1758)	+	+
Loliginidae		
<i>Loligo vulgaris</i> (Lamarck, 1798)	+	
Ommastrephidae		
<i>Illex coindetii</i> (Verany, 1839)	+	+
<i>Omastrephs bartramii</i> (Le Sueur, 1821)	+	+
Crustaceans		
Aristeidae		
<i>Aristeus antennatus</i> (Risso, 1816)	+	
Nephropidae		
<i>Homarus gammarus</i> (Linnaeus, 1758)	+	
<i>Nephrops norvegicus</i> (Linnaeus, 1758)	+	
Palinuridae		
<i>Panulirus rissonii</i> (Desmarest 1825)	+	+
<i>Palinurus mauritanicus</i> (Gruvel, 1911)	+	+
<i>Palinurus elephas</i> (Fabricius, 1787)	+	
Penaeidae		
<i>Parapenaeus longirostris</i> (Lucas, 1846)	+	
Scyllaridae		
<i>Scyllarus arctus</i> (Linnaeus, 1758)	+	
Squillidae		
<i>Squilla mantis</i> (Linnaeus, 1758)	+	

3. Composition of landings

This result shows that the landings of trawlers represent 54% of the species landed at the port of Al Hoceima, followed by longliners which characterized by 29% and for seiners a percentage of the order of 17%. Catches by trawlers are characterized by a higher diversity of species compared to longliners and seiners (**Table 5**). Landing was dominated by sardines and octopus given the commercial value they occupy.

CONCLUSION

In conclusion, Al Hoceima Bay is an important area for several marine species. The proper management of these species exploitations began with the knowledge of many different characteristics of the fishing fleet and the techniques used to exploit these species in this region. The majority of the inshore fishing fleet in the port of Al Hoceima is made up of 14 seiners, 15 trawlers, 16 longliners. This activity provides 617 direct jobs. Active fishing vessels land 120 species. , Each fishing segment using different gear, for seiners using purse seine which are lately damaged by interactions with bottlenose dolphins, the main target

species sardines and anchovies, for longliners using hook and line fishing, the activity is periodic thanks to the biological meals of the main target species (swordfish and bluefin tuna). In addition, trawlers using conical trawl trawls, The main species caught by trawlers include shrimp, Cephalopods (Octopodidae, Sepiidae) and Crustaceans (Penaeidae).

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