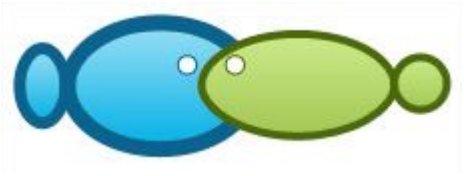

Distribution of black hakes *Merluccius senegalensis* and *Merluccius polli* along the Moroccan Atlantic coast

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Abstract. In the Northwestern coast of Africa three species of hakes overlap. These include European hake *Merluccius merluccius* (Linnaeus, 1758), Senegalese hake *Merluccius senegalensis* Cadenat, 1950 and Benguela hake *Merluccius polli* Cadenat, 1950. The Black hakes *M. senegalensis* and *M. polli* have their northern distribution limit in Morocco. In this study, this limit was set to 33.05°N (33° 3' 0" N) for *M. senegalensis* and 28.28°N (28° 16' 48") for *M. polli*. The fluctuation in the northern limit of the black hakes distribution could be a result of changes in oceanographic parameters (as the area is affected by the upwelling and considered as a transition zone between a warm and a cold region) or a seasonal migration of the species. A misidentification of species is not excluded. The general trend of the yield's average decreases with latitude. South of the latitude 25°N *M. polli* is more abundant in average than *M. senegalensis* even if the latter could show some high yield spots (up to 155 kg h^{-1}). North of the latitude 25°N, the situation is inversed. Black hakes were caught up to about 1000 m depth (1055 m for *M. senegalensis*, deeper than the ever-reported depth). *M. polli* showed a deeper distribution than *M. senegalensis* and was absent from the strata shallower than 300 m. The main concentration of *M. polli* was between 500 and 700 m where 81% of individuals are caught. The main concentration of *M. senegalensis* was in the stratum 300-600 m where 77% of individuals are caught. The maximum overlap of the two black hakes species was between 400 and 600 m suggesting a deeper population in the northern zone of the distribution of these species. Although *M. senegalensis* shows a maximum size (73 cm) greater than *M. polli*'s maximum size (66 cm), its average size in the study area (44.06 cm) was significantly smaller than *M. polli*'s average size (48.84 cm). The black hakes are considered as shared resources and need more studies with a regional scope so as to contribute to their management.

Key Words: black hakes, *Merluccius senegalensis*, *Merluccius polli*, Latitudinal distribution, bathymetrical distribution, center of gravity.

Introduction. Hakes of the genus *Merluccius* are widely distributed throughout the world and form a group of demersal fishes intensely exploited (Alheit & Pitcher 1995; Lloris et al 2005). Up to date, there are sixteen valid species of the genus *Merluccius* (Froese & Pauly 2016). In Morocco, three species of hakes cohabit. These include European hake *Merluccius merluccius* (Linnaeus, 1758), Senegalese hake *Merluccius senegalensis* Cadenat, 1950 and Benguela hake *Merluccius polli* Cadenat, 1950. The last two species are commonly named "black hakes". Hakes are mainly exploited by multi-specific fisheries consisting of coastal trawlers, longliners, industrial trawlers (non-freezers and freezers) and small-scale fisheries. External morphological similarities among hake species, especially those cohabiting the same area, have led to confusion in species identification and catch declarations. The issue of hake distribution overlapping has been treated in the literature for biological or ecological studies (Alheit & Pitcher 1995; Fernández Peralta et al 2008, 2012, 2013a, 2017) or studies on foodstuffs control and detection of fraud (Perez & Garcia-Vazquez 2004; Machado-Schiaffino et al 2008; Garcia-Vazquez et al 2009, 2011; Muñoz-Colmenero et al 2015).

Limits of hake's geographical distributions along the African coasts remain poorly studied due to their morphological resemblance, the taxonomic status of some species that varied between subspecies and full species (Lloris et al 2005; Carpenter & De Angelis 2016) and the reduced number of scientific surveys (especially those carried out on the slope). Sometimes, distinguishing hake species is difficult (even for scientists) and some taxonomic skills are needed (Lozano Cabo 1965).

The regular demersal scientific surveys of the National Institute of Fisheries Research (INRH) is directed mainly to the cephalopods assessment south of Cape Boujdour in depths not exceeding 150 m and *M. merluccius* and the deep-water rose shrimp (*Parapenaeus longirostris*) north of Sidi Ifni (29°N30'). Therefore, they cannot provide information on the state of the black hakes stock with a deeper and southern distribution. Thanks to the scientific and technical cooperation with foreign institutions and international projects, research surveys were carried out in this area from the year 2000 with objective of the exploration of a part of the slope.

The proportion of each of the three species of hake (the two species of black hakes and the European hake) in the landings is not known in the area where at least two species of hakes overlap. In the statistics, the catch is either attributed to one of the three species (in fact only European hake and Senegalese hake are cited in the official statistics of the National Fisheries Office), or to a generic name without any reference to the species. Thus, 62% of the landings of the artisanal and coastal fisheries from 2009 to 2015 are attributed to *M. merluccius*, and 1% to *M. senegalensis*. The rest (37%) is assigned to the French generic names "merlan", "merlu", "colin" and "merluchon" (Anonymous 2010, 2011, 2012, 2013, 2014, 2015, 2016). The two latter names had a reference to the size of the hakes.

Thus, the evaluations in the FAO/Fishery Committee for the Eastern Central Atlantic (CECAF) considers for simplification, a stock of *M. merluccius* north of 29°N and a stock of black hakes in the south (evaluated together as a single species *Merluccius* spp.) (FAO 1979, 1986, 1990, 2006a, 2012, 2015).

This study will present the results of surveys carried out by research vessels over a decade from 2004 to 2014 in the slope of the Moroccan Atlantic area. Although three species of hakes are found in the catch, this study focuses on the distribution of black hakes *M. senegalensis* and *M. polli* in order to contribute to the knowledge of their pattern along the Moroccan coast and the management of their fisheries.

Material and Method. The Moroccan Fisheries Institute (INRH) has conducted a series of demersal surveys to prospect the slope (especially in the southern zone) in cooperation with the Norwegian program Nansen, the Spanish Institute of Oceanography (IEO), the Russian Institute Atlantniro and the CCLME project (Canary Current Large Marine Ecosystem). Recently, two surveys were carried out with the own ship of INRH in 2013 and 2014 to prospect the black hake stock and the associated demersal fauna. This study uses all the data provided by the above-cited surveys.

Sea surveys and survey design. The main set of data is composed by:

- three surveys by the Spanish R/V "Vizconde De Eza" (VDE) conducted between 2004 and 2006, from mid-November to mid-December, covering the area from Cap Spartel (35°N56') to Cap Blanc (21°N6'), although different areas each year, and depths from 500 m to 2000 m. A bathymetric stratum between 200 m to 500 m depth was added in the area south to 25°N30'. The duration of trawling was 1 hour and the total number of stations is 282. Sampling was carried out by the swept area method according to a stratified random sampling scheme in a geostatistical approach. This method consists in distributing a number of points in a regular mesh within each stratum by one point per cell. The number of points (or mesh cells) per stratum is calculated in proportion to the area of the stratum standardized by the sampling weight. The strata defined by depths were: from 500 to 800 m, from 800 to 1200 m, from 1200 to 1500 m and from 1500 to 2000 m. In the 2006 survey, the stratum 200-500 m was added;

- one survey using the Russian R/V "Atlantida" (ATL) in May 2005 covering the area from Cap Ghir (30°N31') to Cap Blanc (20°N58') at depths ranging from 200 to

1000 m. The trawling duration was of 30 minutes and the yield was standardized to 1 hour. The number of stations is 61. The sampling network is arranged on radials spaced 30' between latitudes 30°N30 and 21°N00. The trawl line follows approximately the isobath line. Trawl stations are chosen at depths ranging from 200 to 1000 m in each radial. The strata of depth are: 200-450 m, 450-700 m and 700-1000 m;

- two surveys carried out by the Moroccan research vessel "Charif Al Idrissi" (CAI) in March-April 2013 and October-November 2014 totaling 75 stations of 30 minutes trawling, standardized to 1 hour. The depth ranged from 45 to 800 m. A survey design by radials every one latitudinal degree between 29°N and 21°N was adopted. The bathymetric strata were: < 200 m; 200-300 m; 300-500 m; 500-600 m; 600-700 m and > 700 m.

Besides of this set of data, additional data and observations are used from:

- a survey carried out by the Norwegian vessel "Dr. Fridtjoff Nansen" (DFN) in October 2000. The survey covered the area between 28°N and 21°N at depths between 150 and 800 m. Total stations of the survey are 90. The trawls were positioned according to a stratified systematic sampling protocol with geographic and bathymetric stratification. The radials are perpendicular to the coast, spaced by 40 to 50 nautical miles and are composed of 7 stations. The sampling design was based on seven bathymetric strata (150-200 m; 200-300 m; 300-400 m; 400-500 m; 500-600 m; 600-700 m; and 700-800 m) and the trawls were carried out during the day and the night. The duration of each trawl is 30 minutes;

- a couple of the CCLME project surveys carried out in November-December 2011 and 2012 on board of the Norwegian vessel "Dr. Fridtjoff Nansen". The survey transects were made perpendicular to depth isobaths and spaced 20 nautical miles (NM) apart. They covered the depth interval between 20 m and 500 m depth. Bottom trawling was conducted within four different depth strata on each of these transects, between 20-50 m, 50-100 m, 100-200 m and between 200-500 m depth. Occasional trawls were conducted deeper than 500 m. However, from the 269 trawls, only 6 trawl exceed 400 m depth and are all northern than black hakes limit.

A summary of the description of the surveys is given in the Table 1. The number of stations by latitude and by depth is shown in Figures 1 and 2 respectively.

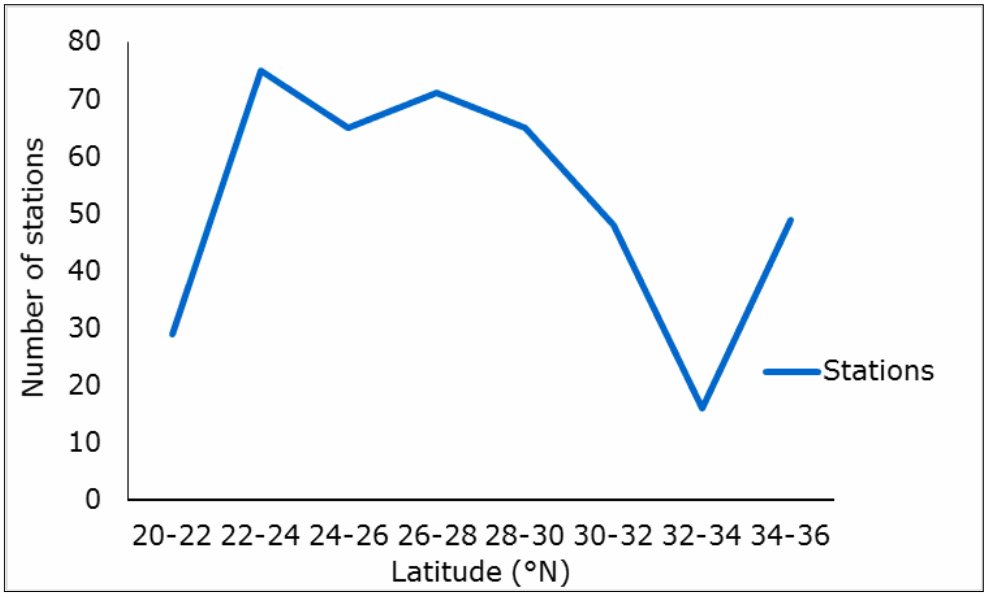

Figure 1. Number of stations by latitude of the main set of data.

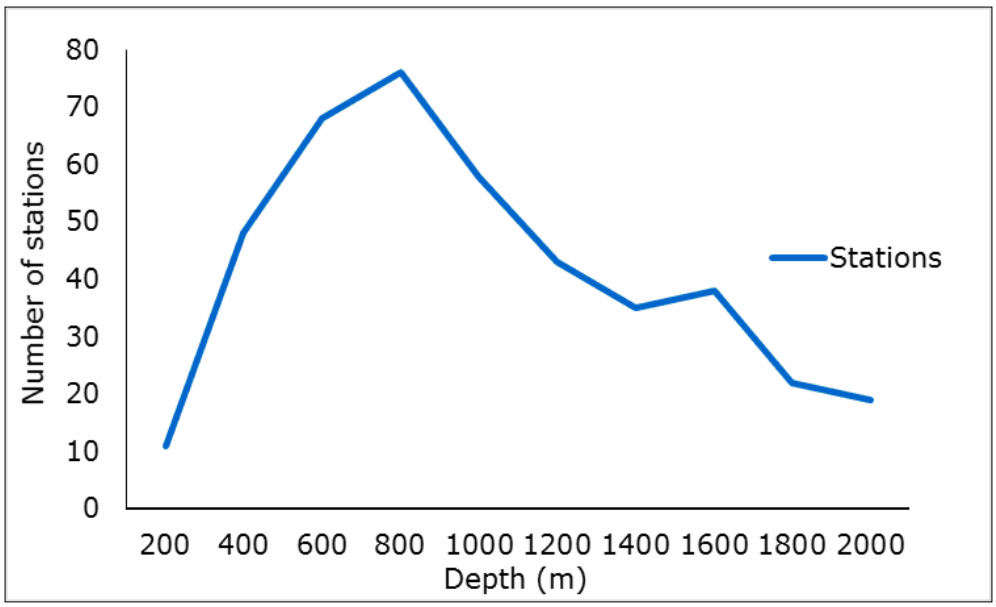

Figure 2. Number of stations by depth of the main set of data.

Table 1

Recapitulation of surveys data description

Vessel	*Period*	*Min latitude*	*Max latitude*	*Min depth (m)*	*Max depth (m)*	*Stations*	*Data use*
DFN	7 to 20 Oct. 2000	21.3°N	27.8°N	150	780	90	In part
VDE	13 Nov. to 14 Dec. 2004	30.2°N	35.9°N	506	1851	88	Full
ATL	03 to 29 May 2005	21.0°N	30.5°N	217	913	61	Full
VDE	14 Nov. to 14 Dec. 2005	26.1°N	30.9°N	500	1861	95	Full
VDE	14 Nov. to 13 Dec. 2006	21.1°N	25.5°N	229	1845	99	Full
DFN	18 Nov. to 16 Dec. 2011	21.0°N	34.2°N	28	583	124	In part
DFN	11 June to 14 July 2012	21.0°N	35.7°N	29	573	145	In Part
CAI	5 to 25 March 2013	22.1°N	29.3°N	46	778	39	Full
CAI	29 Oct. to 06 Nov. 2014	21.0°N	29.1°N	90	749	36	Full

Center of gravity. A multitude of maps can be produced based on all these survey data. So as to synthesize the bulk of information they contain in a small number of graphs the center of gravity and inertia are good tools (Bez 1997; Ould Taleb Ould Sidi 2007).

The center of gravity of a set of data is calculated as an average of the positions of the samples weighted by the observed catches:

$$Lat_{avg}=(\Sigma Lat_i \, .Y_i \,)/\Sigma Y_i \qquad Long_{avg}=(\Sigma long_i \, .Y_i \,)/\Sigma Y_i$$

with Y_i = Yield in kg h^{-1} of the considered species at the station i with the coordinates Lat_i and $Long_i$.

To determine the variability of these centers of gravity, inertia of each coordinate is calculated:

$$\Sigma Y_i \, (Lat_i - Lat_{avg})^2/\Sigma Y_i \qquad \Sigma Y_i \, (Long_i - Long_{avg})^2/\Sigma Y_i$$

Biological sample. The biological sample consist of 1701 individuals sized to the total length (TL) of which 814 belong to *M. senegalensis* (size range from 18 to 73 cm TL) and 887 to *M. polli* (size ranged from 14 to 66 cm TL).

Data analysis. All data were presented as the average ± standard deviation (SD) of the sample. Statistical analyses of data were carried out with R software 2.15.2. Significance of differences was defined at $p < 0.05$. The maps were produced with ArcMap 10.

Results and Discussion. The positions of trawling stations are reported on the maps as well as the occurrence for *M. senegalensis* (Figure 3a) and *M. polli* (Figure 3b).

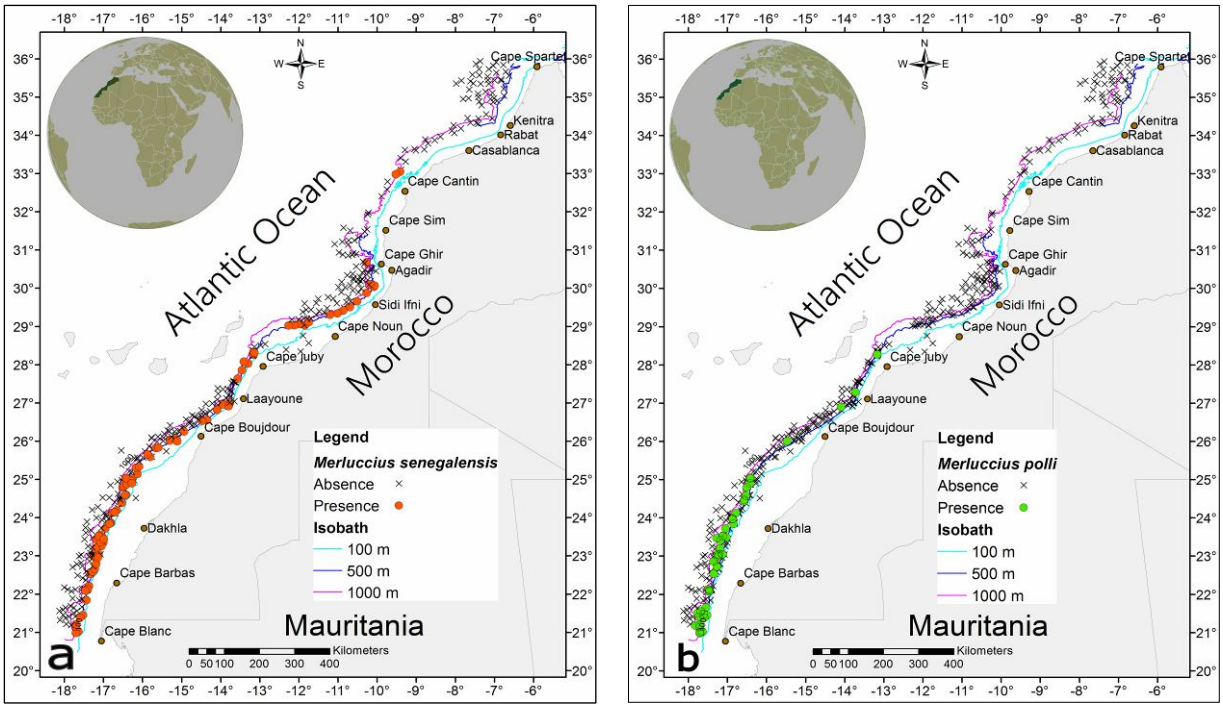

Figure 3. Map of presence/absence of *M. senegalensis* (a) and *M. polli* (b) in the study area.

The two black hakes were present in 24% and 13% of the trawls for *M. senegalensis* and *M. polli* respectively. The latitudinal distribution of the black hakes started from the southern station carried out to 33.05°N (33° 3' 0" N) for *M. senegalensis* and 28.28°N (28° 16' 48") for *M. polli*.

The latitudinal distribution of the black hakes is larger than the study area. The interesting fact in this study is to examine the distribution's northern limit of the two species.

For *M. senegalensis*, the usual distribution reported is from Cape Cantin (32.54°N) in Morocco to Cape Roxo (12.41°N) in Senegal (Cohen et al 1990; Ramos Martos & Fernández Peralta 1995; Lloris et al 2005; Carpenter & De Angelis 2016). Maurin (1954) reported the presence of *M. senegalensis* in the area of Cape Cantin and notified that is rare near Casablanca but reported that it was landed by a Spanish longliner in Port-Lyautey (actual Kenitra 34.25°N). Bravo de-Laguna (1982) set Rabat (about 34°N) as the northern limit of *M. senegalensis*.

M. polli was known as *Merluccius cadenati* Doutre 1960 until 1990. The usual distribution reported is from Cape Barbas (22.3°N) to Namibia 18.5°S (Lloris et al 2005; Carpenter & De Angelis 2016). Maurin (1963) reported its presence in two trawls between Cape Juby and Cape Boujdour on depth over 500 m. Bravo de-Laguna (1982) presented a map with a northern limit of Benguela hake at Cape Juby (28°N) at the working group of CECAF in 1978.

The fluctuation in the northern limit of the black hakes distribution may suggests a southern regression of African hakes due to oceanographic parameters (FAO 1979; Garcia 1982). It is not excluded that this fact is due to a misidentification of species (Garcia 1982; Lloris et al 2005). A seasonal migration is also a hypothesis often reported (Garcia 1982; FAO 1986, 1990, 2006a, 2006b, 2015; Lloris et al 2005; Fernández Peralta et al 2008, 2011, 2017; Carpenter & De Angelis 2016).

On the other hand, Meiners et al (2010) described how the North Atlantic Oscillation (NAO) index impacts black hakes dynamics in northwest Africa and found that abundance of black hakes was highly and negatively correlated with the NAO index, with a time lag of 3 years. Indeed, the distribution pattern and migration are greatly

correlated to environmental parameters, especially in the area affected by the upwelling and considered as a transition zone between a warm and a cold region.

The center of gravity was calculated on the main data for the two species of black hakes. For *M. senegalensis* the center of gravity was in 24.20°N, -15.79°W with an inertia of 9.51 for latitudes and 6.95 for longitudes (Table 2). For *M. polli* it was in 22.56°N, -17.22°W with an inertia of 2.46 for latitudes and 0.52 for longitudes (Table 3).

Table 2

Centre of gravity and inertia of *M. senegalensis*

Survey	*Center of gravity*		*Inertia*	
	Latitude	*Longitude*	*Latitude*	*Longitude*
Atlantida	23.49	-16.00	11.06	8.08
Vizconde de Eza	24.75	-15.44	9.86	7.35
CAI 2013	24.15	-16.32	3.65	1.99
CAI 2014	24.55	-15.92	6.07	3.18
Total	24.20	-15.79	9.51	6.95

Table 3

Centre of gravity and inertia of *M. polli*

Survey	*Center of gravity*		*Inertia*	
	Latitude	*Longitude*	*Latitude*	*Longitude*
Atlantida	21.66	-17.56	0.45	0.03
Vizconde de Eza	22.34	-17.39	1.26	0.16
CAI 2013	24.88	-16.21	1.15	0.99
CAI 2014	22.11	-17.38	2.09	0.26
Total	22.56	-17.22	2.46	0.52

The analysis of the center of gravity shows that average distribution of black hakes is located in latitude 24.20°N for *M. senegalensis* and 22.56°N for *M. polli*. The values by surveys shows minimal numbers for both species for the survey Atlantida carried out on May 2005. It means that the distribution of black hakes was more southern in that period. The value of the Center of gravity of the survey carried out by the R/V CAI in 2013 is higher for *M. polli* because trawling was not achieved in latitude 21°N due to a damage in fishing gear (Figure 4).

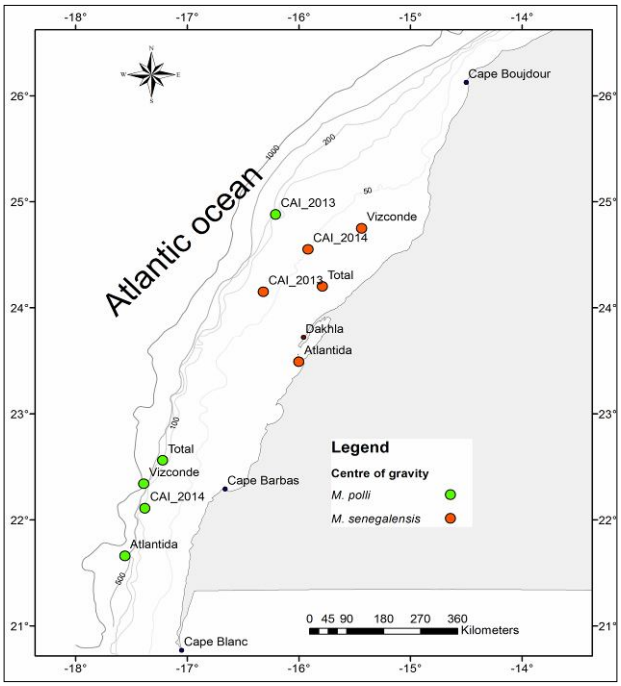

Figure 4. Centre of gravity of black hakes distribution.

The general trend of the yield's average showed a decrease with latitude for the two species (Figure 5). The yield was 8 kg h^{-1} and 18 kg h^{-1} for *M. senegalensis* and *M. polli* respectively in latitude 21°N. *M. polli* showed two peaks of less importance in latitude 24-25°N and 27-28°N. For *M. senegalensis*, the average yield's was continuous alongshore, decreasing between 21°N and 25°N but slightly increasing from 25°N to 31°N.

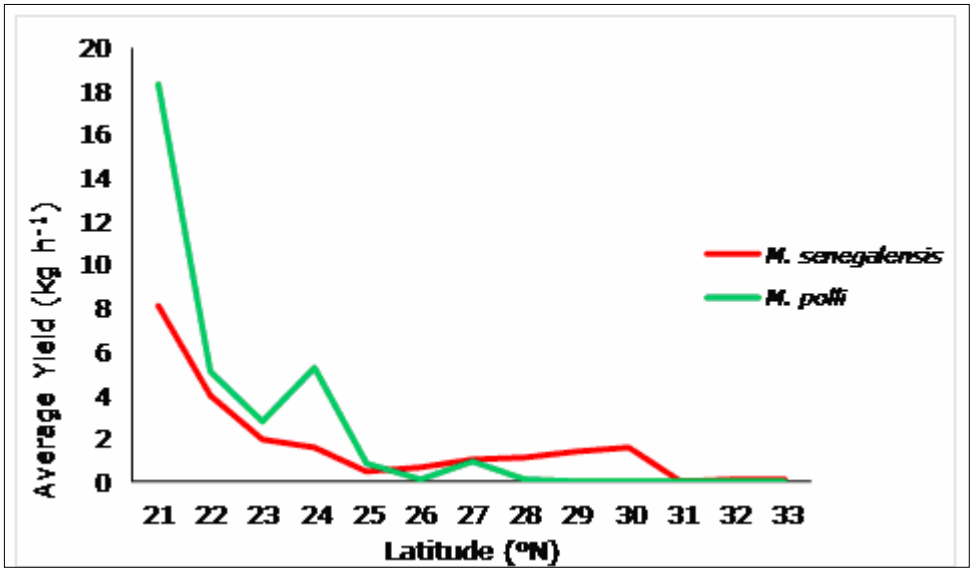

Figure 5. Latitudinal distribution of average yields (expressed in kg h^{-1}) of *M. senegalensis* and *M. polli*.

The maximum yield by latitude showed the same trend of the average yield (Figure 6). However, maximum value of *M. senegalensis* was 155 kg h^{-1}, exceeded 121 kg h^{-1} realized by *M. polli* at the same station on May 20th, 2005 by the R/V "Atlantida" (21.48°N,-17.61°W; 522 m depth).

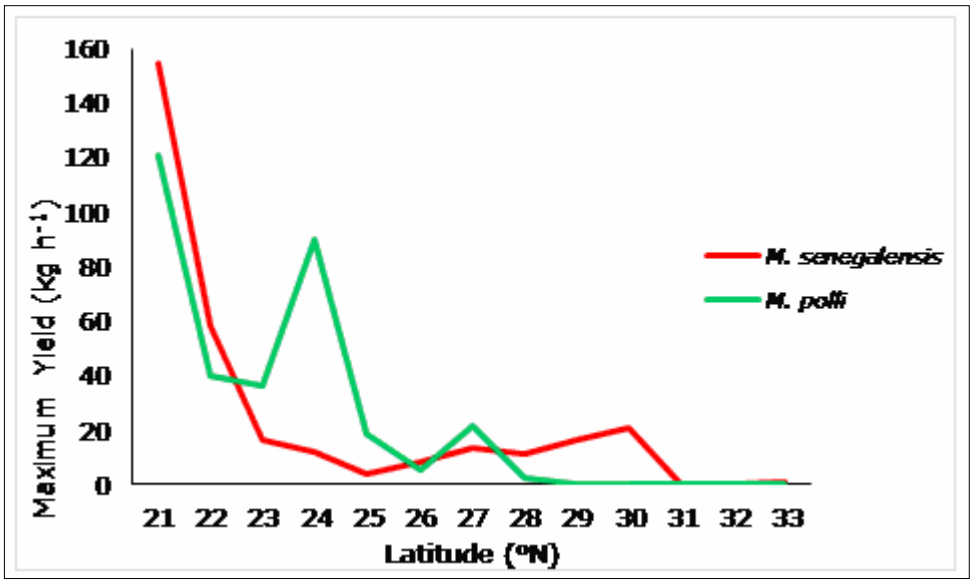

Figure 6. Latitudinal distribution of maximum yield (expressed in kg h^{-1}) of *M. senegalensis* and *M. polli*.

In next paragraphs, the main source of comparison will be a study on black hakes in Mauritania (adjoining our study area) using a set of data from commercial vessels and another set from oceanographic surveys carried out with the Spanish R/V "Vizconde de Eza", from 2007 to 2010. The details of this study are widely described in Fernández

Peralta et al (2013a, 2017). As our data came from research vessels, we will refer mainly to the results of the oceanographic surveys rather than those of commercial vessels.

The average yield of the black hakes at the southern limit of the study (21°N) is 8.2 Kg h^{-1} and 18 Kg h^{-1} for *M. senegalensis* and *M. polli* respectively. The same species shows in Mauritania (at 20°N) 8 kg h^{-1} and 29 respectively. These results confirm the homogenous pattern of *M. senegalensis* with a maximum yields at 17°N (22 kg h^{-1}) and at 19°N (20 kg h^{-1}) (Fernández Peralta et al 2013a) and a smooth decrease in the northern limit. *M. polli* shows a marked peak at 17°N with 148 kg h^{-1} and a sharp decrease around this peak. At 19°N the average yield of *M. polli* is about 50 kg h^{-1}.

The maximum depth reported for the black hakes is 800 m and 1000 m for *M. senegalensis* and *M. polli* respectively (Carpenter & De Angelis 2016; Lloris et al 2005). In our data set, these hakes were found up to 1055 m for *M. senegalensis* and 995 m for *M. polli*. In Mauritanian waters, Fernández Peralta et al (2013a) reported maximum depth 713 m and 1098 m for *M. senegalensis* and *M. polli* respectively.

The bathymetric distribution of *M. senegalensis* was large. It was caught in 99 stations from a total of 418 carried out between 161 m and 1055 m. The average is 471 m with a standard deviation of 178.64. For *M. polli*, the depth of the 53 stations ranged from 335 m to 995 m. The average is 626 m with a standard deviation of 143.35. The Student t-test showed a significant difference between the mean depth of the two black hakes species (Figure 7).

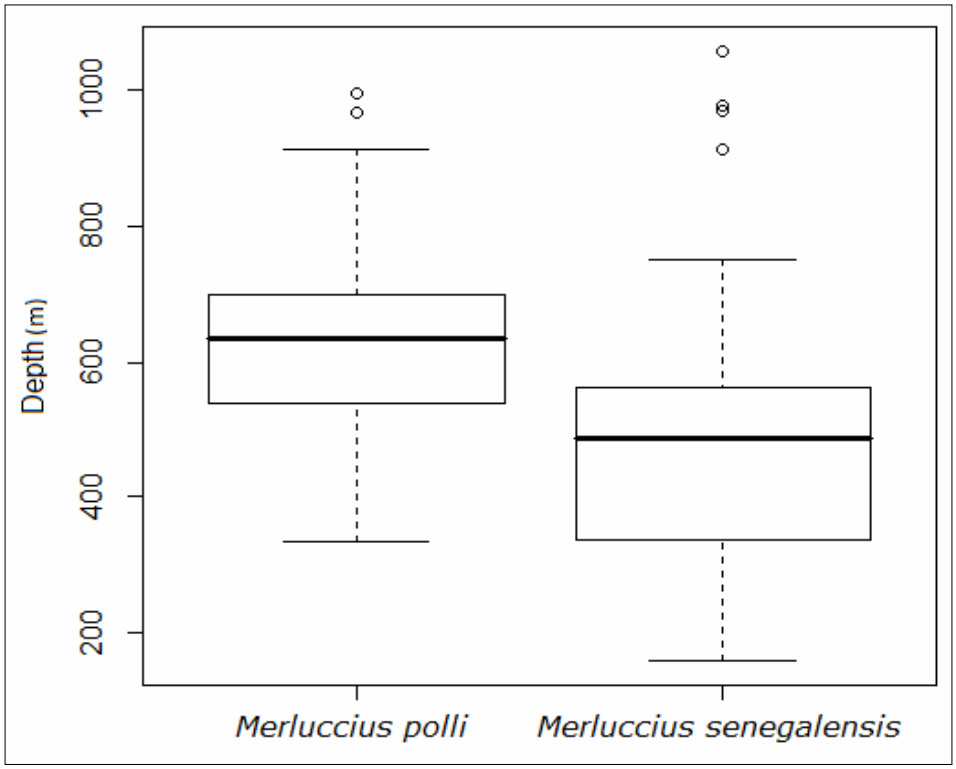

Figure 7. Boxplot of the depth distribution of *M. senegalensis* and *M. polli.*

The significant difference between the mean depth of the two black hakes species shows that *M. polli* is found deeper than *M. senegalensis*. This result is conform to precedent studies (Fernández Peralta et al 2006, 2008, 2011, 2013b; Quintanilla et al 2013).

The Figure 8 shows that only 5% of the individuals of *M. senegalensis* was caught deeper than 600 m, even if the maximum depth reached was 1055 m. The main concentration of this hake species is in the stratum 500-600 m where 38% of individuals are caught. The strata from 200 to 600 m cumulate 92% of the total catch of *M. senegalensis*. For *M. polli*, it was totally absent in the strata shallower than 300 m. The cumulate proportion of this species in the strata shallower than 500 m is only 11%. The main concentration is between 500 and 700 m where 81% of individuals are caught. The

Figure 9 shows that *M. senegalensis* represent the total black hakes in the shallow strata below 300 m. Gradually their proportion decrease where the proportion of *M. polli* increase. In the stratum 500-600 m the two species are found in equal proportion, but in the strata deeper than 600 m, *M. polli* is the most abundant black hake. Beyond 900 m of depth, only 11 individuals are caught, 4 Benguela hakes and 7 Senegalese hakes, so the size of the sample cannot reveal a robust trend.

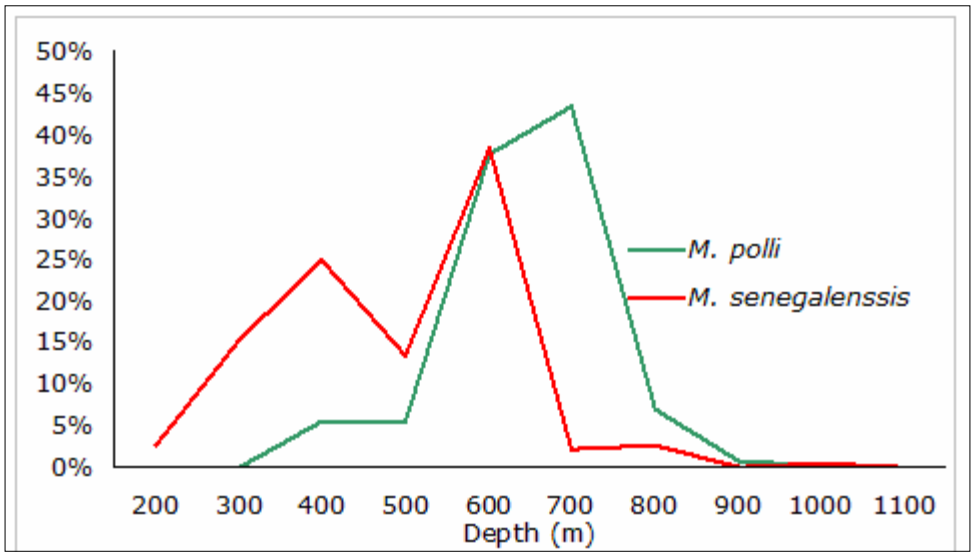

Figure 8. Bathymetric distribution of the black hakes *M. senegalensis* and *M. polli.*

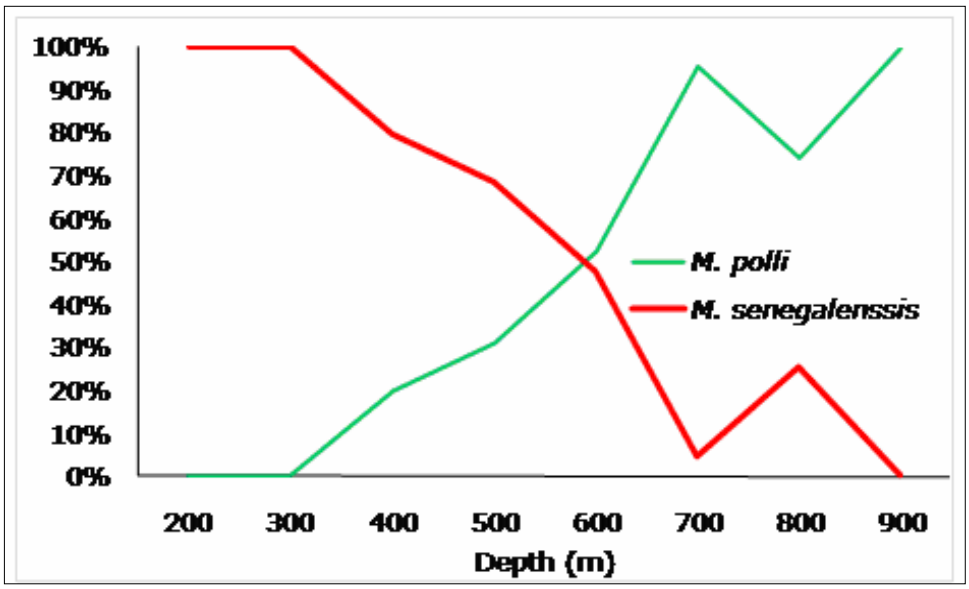

Figure 9. Proportion of each species of black species by bathymetric strata.

M. polli was absent from the strata shallower than 300 m our study area. A similar situation was reported by (Maurin 1963) based on survey data of R/V "Thalassa" in 1962 when the presence of *M. polli* started at 500 m depth between cape Boujdour and cape Barbas and 350 m depth between the cape Barbas and the cape Blanc. However, in Mauritanian waters this species was found in shallowest bottoms (80-100 m) explored in the surveys, although with low yields (6.5 kg h^{-1}) that strongly increased between 200-300 m (200 kg h^{-1}) (Fernández Peralta et al 2013a, 2017).

The maximum overlap of the two black hakes species was between 400 and 600 m where 58% and 42% of *M. senegalensis* and *M. polli* respectively were present. In Mauritania, the maximum mixing of the two species was observed between 200 and 500 m (Fernández Peralta et al 2013a). This could suggest a deeper population in the northern zone of the distribution of these species. Nevertheless, the results from

Mauritania were obtained in the same hydrological season (transition warm-cold), when these species show a less depth distribution, compared with warm or transitional cold-warm hydrological season (Fernández Peralta et al 2012). The hydrological regime in Mauritanian waters is very marked by the displacement of a marine front which reaches the cape Blanc latitude (Sevrin-Reyssac 1993; Peña-Izquierdo et al 2012).

The boxplot size distribution in Figure 10 and the length frequency in Figure 11 summarizes the size features of the black hakes' sample.

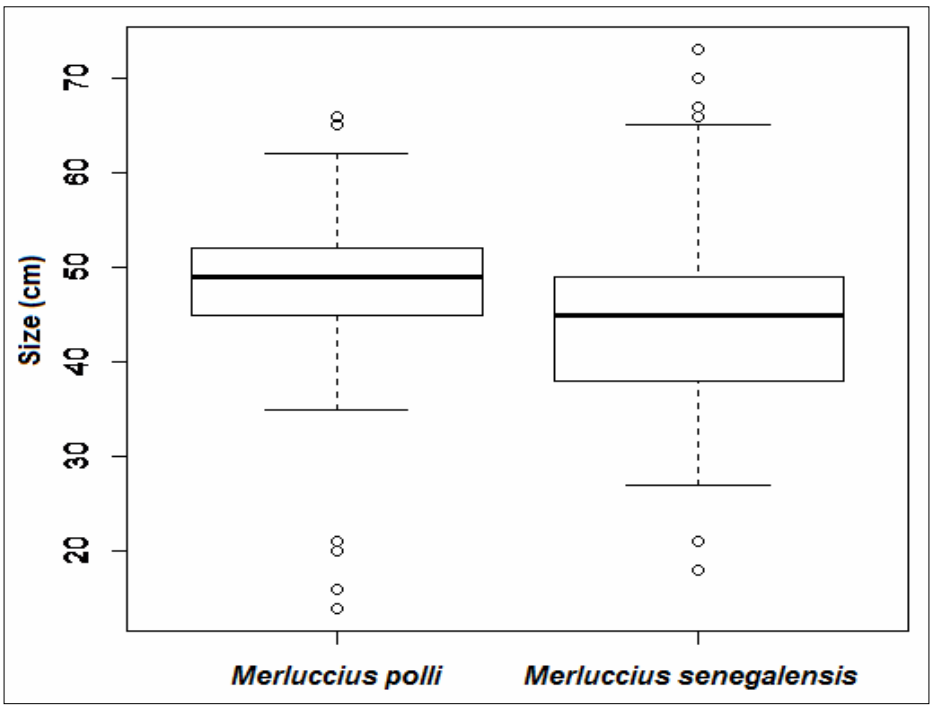

Figure 10. Boxplot of black hakes sizes.

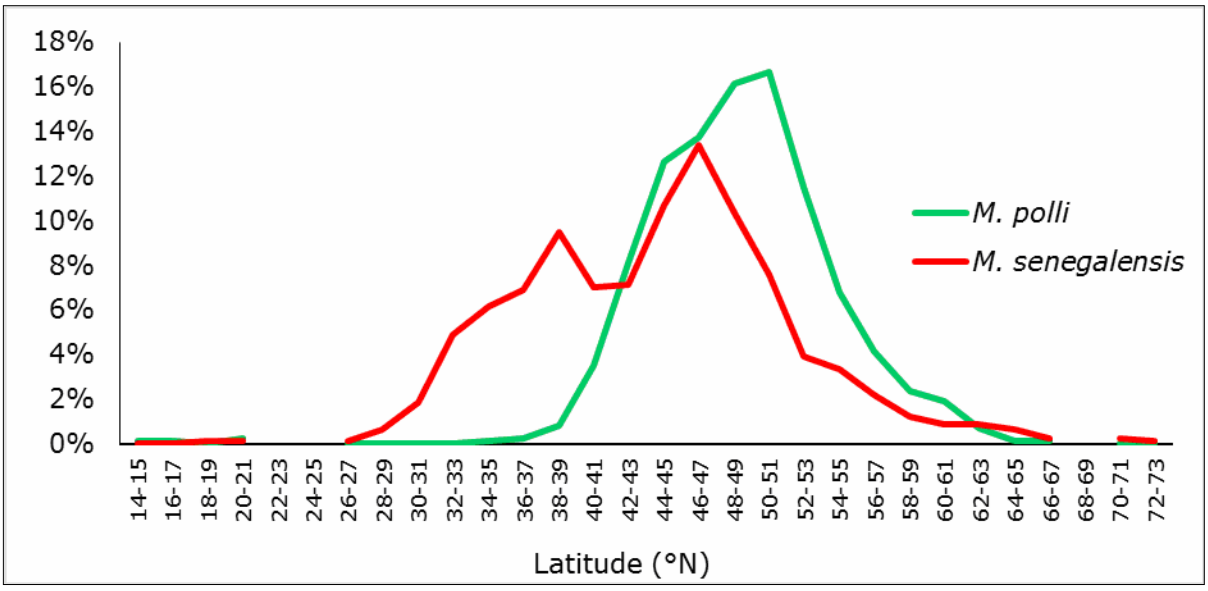

Figure 11. Length frequency distributions of *M. polli* and *M. senegalensis.*

The size frequencies of *M. senegalensis* show a bimodal distribution, the first mode is located in the size 39 cm and the second in the size 46 cm while *M. polli* show a unimodal distribution with a mode represented in the size 49 cm (Figure 10). The maximum size reached was 73 cm and 67 cm respectively for *M. senegalensis* and *M. polli*.

The average size of *M. senegalensis* was 44.06 cm ± 7.50; while the average size of *M. polli* was 48.84 cm ± 5.25. The Student t-test showed a significant difference between the mean sizes of the two black hakes species.
The maximum sizes reported is 87 cm and 80 cm for Senegalese hake and Benguela Hake respectively (Lloris et al 2005; Carpenter & De Angelis 2016). In our sample, maximum size encountered was 73 cm and 66 cm for *M. senegalensis* and *M. polli* respectively. In Mauritania, the maximum size reported was 85 cm and 75 cm for *M. senegalensis* and *M. polli* respectively (Fernández Peralta et al 2013b).

The average size by stratum shows a similar profile for the two species of black hakes. The general trend is the size increase as the depth increases, although a slight decrease is noticeable for *M. senegalensis* at the shallowest strata (Figure 12).

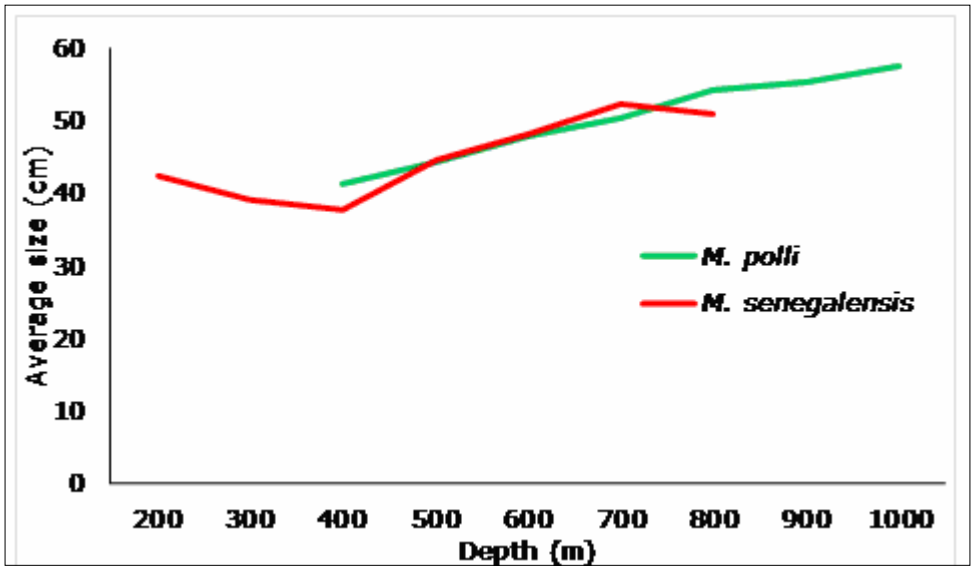

Figure 12. Average size by depth stratum for the black hakes.

Although *M. senegalensis* shows a maximum size greater than *M. polli*, his average size in the study area was significantly smaller. This issue is the result of a bimodal size frequencies and a shallower distribution of the population composed by individuals of minor size. Indeed, the mean size tend to increase by depth as already reported (Caveriviere et al 1986; Turner & El Ouairi 1986; Fernández Peralta et al 2013b).

Conclusions and perspectives. The Moroccan coast is considered as the northern limit of black hakes distribution. The fluctuation in this limit could be a result of changes in oceanographic parameters, a seasonal migration or just misidentification of these species.

The general trend of the yield's average decrease with latitude. South of the latitude 25°N *M. polli* is more abundant in average than *M. senegalensis* even if the latter could show some high yield spots. North of the latitude 25°N, the situation is inversed.

M. senegalensis showed a large latitudinal distribution, shallower presence and an average size smaller than *M. polli*.

The black hakes are poorly studied in Morocco compared to other resources like pelagic fish, cephalopods, shrimps and European hake. In the last decade, several research surveys were carried off Moroccan Atlantic ocean in cooperation with foreign oceanographic institutes, international projects and with the own research vessels of INRH with as objective the exploration of deeper resources, hakes among others. These surveys allowed us to identify main characteristics of the biology and ecology of black hakes in Moroccan waters.

However, much work remains to be done to study other aspects, especially those that are constantly recommended every CECAF working group: sampling and observing of commercial landings (and discards) and their allocation by species and size, especially for the fleet fishing under the Morocco-EU fisheries agreement targeting black hakes;

perform specific studies on stock identity of black hakes among the region; conduct studies on early life of black hakes, especially eggs, larvae and recruits and identify the nursery grounds.

Some of these research perspectives are already started by the INRH, but there is no need to argue that the scope of these studies must be regional so as to contribute to the management of these shared resources.

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