Black hake (*Merluccius polli* and *M. senegalensis*) off Mauritania: spatio-temporal distribution of two sympatric species. 1. Yields

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INTRODUCTION

Black hakes (*Merluccius polli* and *M. senegalensis*) are demersal species that have supported important fisheries in northwest African waters off Morocco, Mauritania and Senegal. For more than 50 years, black hakes have been the main target species for Spanish fresh trawlers, occasionally longline fleets and by number of trawlers' fleets from other countries. Unknown amounts of black hake species are also bycaught by multiple fleets of different nationalities (FAO, 1978; 1986a,b; 1990; 1995; 1997; 2006a,b; 2010; 2011; Thiam, 1989; Thiam *et al.*, 1990; Ramos y Fernández, 1992; 1994; 1995).

Nowadays, only Mauritanian waters, spanning about 5 degrees of latitude, sustain a commercial fishery for black hakes, where both species overlap and have always shown to be the most abundant.

In the 70's, Russian, Spanish and Portuguese trawlers' fleets landed annually more than 100000 t of black hakes (*Merluccius* spp.) from NW African waters (FAO, 1978, 1986a, 1990; 1995; Ramos y Fernández, 1992; Ramos *et al*., 1998), while slightly more than 3000 t were fished in 2012 by a couple of Spanish vessels operating in Mauritanian waters.

All over the globe, hakes show an overlap of at least two species in their intermediate area of distribution (Lloris *et al.*, 2003; Fernández-Peralta *et al.*, 2008), although this is a poorly studied issue (Alheit and Pitcher, 1995), quite difficult to address with. In fact, the morphological resemblance of hake species and the large volumes of their catch, even in research surveys, hinders correct and reliable sorting into species (Machado-Schiaffino, *et al*., 2008; García-Vázquez *et al*., 2009).

In Mauritanian waters, Senegalese black hake (*M. senegalensis*) and Benguela black hake (*M. polli*) are mixed in catches and are commonly marketed as *Merluccius* spp. due to their resemblance and overlapping at certain depths. Senegalese hake is a shallower water species and Benguela hake a deeper water species (Lloris *et al*., 2003; Fernández-Peralta *et al*., 2006). Assessing the proportion of each species in the catch remains complicated, because amongst the previous and scarce available studies, some ones recorded only the Senegalese hake catch, while others recorded data of mixed *Merluccius* spp (Bourdine, 1986; Overko *et al*., 1986). In addition, black hake landings only provide data on the retained catch of the mixed species.

Despite these difficulties, previous studies showed a great abundance of the Senegalese hake, *M. senegalensis* off Mauritania (Boukatine, 1986; Bourdine, 1986; Overko *et al.*, 1986, Cervantes and Goñi, 1986; Sobrino *et al.*, 1990; Wysokinski, 1986; Ramos *et al*., 2001). However, data from recent experimental surveys and sampling programs using observers onboard commercial vessels (Ramos *et al.*, 2004; Fernández-Peralta *et al.*, 2006; FAO, 2010) indicate a significant increase in the abundance of the Benguela hake, *M. polli*, at least in the prospected areas.

For these reasons, black hakes have been evaluated together as if they were a single species, *Merluccius* spp. Even if recent studies on the distribution and biology of Senegalese and Benguela black hakes are providing new evidences of different life strategies in both species (Fernández-Peralta *et al.*, 2010; 2011; Rey *et al.*, 2012; Rey *et al.*, in press), the results of the stock assessments made to date wouldn't be invalidated be our findings.

This study analyzes yield data collected both from commercial vessels and resource assessment surveys to describe the spatio-temporal distribution pattern of the two sympatric black hake species in Mauritanian waters. Improving the knowledge of the biology of these two species will lead to a better estimate of specific percentages in catch, therefore enabling a sustainable fishery resource management.

MATERIAL AND METHODS

We used data from two sources: a series of data from commercial vessels operating in the Mauritanian EEZ and a series of data collected from the oceanographic surveys in waters off Mauritania.

The Instituto Español de Oceanografía (IEO) placed scientific observers onboard commercial Spanish trawlers fishing for black hakes to sample 24 trips throughout years 2007, 2009 and 2011. They sampled a total of 843 hauls carried out between 33 and 1098 m depth. In 774 of these hauls, the observers sorted hakes into species and recorded their corresponding retained and discarded catches, both in weight and in numbers.

We also analyzed data collected during 4 demersal assessment surveys jointly carried out by IMROP (Institut Mauritanien de Recherches Océanographiques et des Pêches) and IEO onboard the Spanish R/V *Vizconde de Eza*, from 2007 to 2010 in mid-November to mid-December of each year. The methodology used in these campaigns is widely described in Ramos *et al.*, 2010 and Hernández-González *et al.*, 2011. The average depth range explored in these campaigns was from 79 to 1867 m, although this study analyzed a total of 189 hauls performed at depths up to 1100 m, the maximum bathymetric occurrence of Benguela hake, *M. polli*. Depending on the bathymetric strata concerned, hauls were of 30 or 60 minutes.

We estimated the frequency of occurrence of the two hake species, using both commercial fishery data and survey data. These frequencies were analyzed regarding to depth, latitude, and on an annual basis for commercial vessels, thus providing valuable information on the strategy of fishing trawlers.

The catches, both retained and discarded, were recorded for each black hake species and by sampled haul. Catch values were further standardized per trawled hour (kg/h) in catch per unit effort (CPUE). We analyzed the spatio-temporal variation of CPUEs with depth and latitude, and we compared the results of commercial trawlers with those of the research surveys.

To analyze the temporal evolution of the yields for the two species over a year, we only used data from commercial sampled trips, since the research surveys were always conducted in November and December. In addition, we excluded some values of the monthly analysis of yields: *M. polli* retained and discarded data of March (only 6 trawls were sampled and provided an abnormal result [outlier]) and *M. senegalensis* retained of September and discarded data both species in the same month (26 trawls were made at very deep bottoms and produced extremely low yield estimations considered erroneous).

To obtain robust information, we grouped all data from the same source (commercial fishing or surveys) and we did not take into account their inter-annual variation.

In order to clarify the discharge ratios in the landings, for each data set (commercial fishing and surveys) we estimated the proportions of both hake species in the study area by bathymetric range. We analyzed separately the discarded (as juveniles) and retained (as adults) fractions in the case of commercial fishing data. The specimens below 35 cm were 90% of discards data (Fernández-Peralta *et al*., 2013).

The results of this study have been compared with those obtained from GAM modelling and presented to this working group by Quintanilla *et al.*, 2013.

RESULTS

Frequency of occurrence

Figure 1 shows the study area and the location of the analyzed hauls from research surveys (a) and commercial vessels (b), as well as the occurrence for each black hake species. As shown, the spatial (21°46'N - 16 03'N) and bathymetric (< 100 to 1100 m depth) distribution area of both species has been extensively sampled, confirming the robustness of data from both sources.

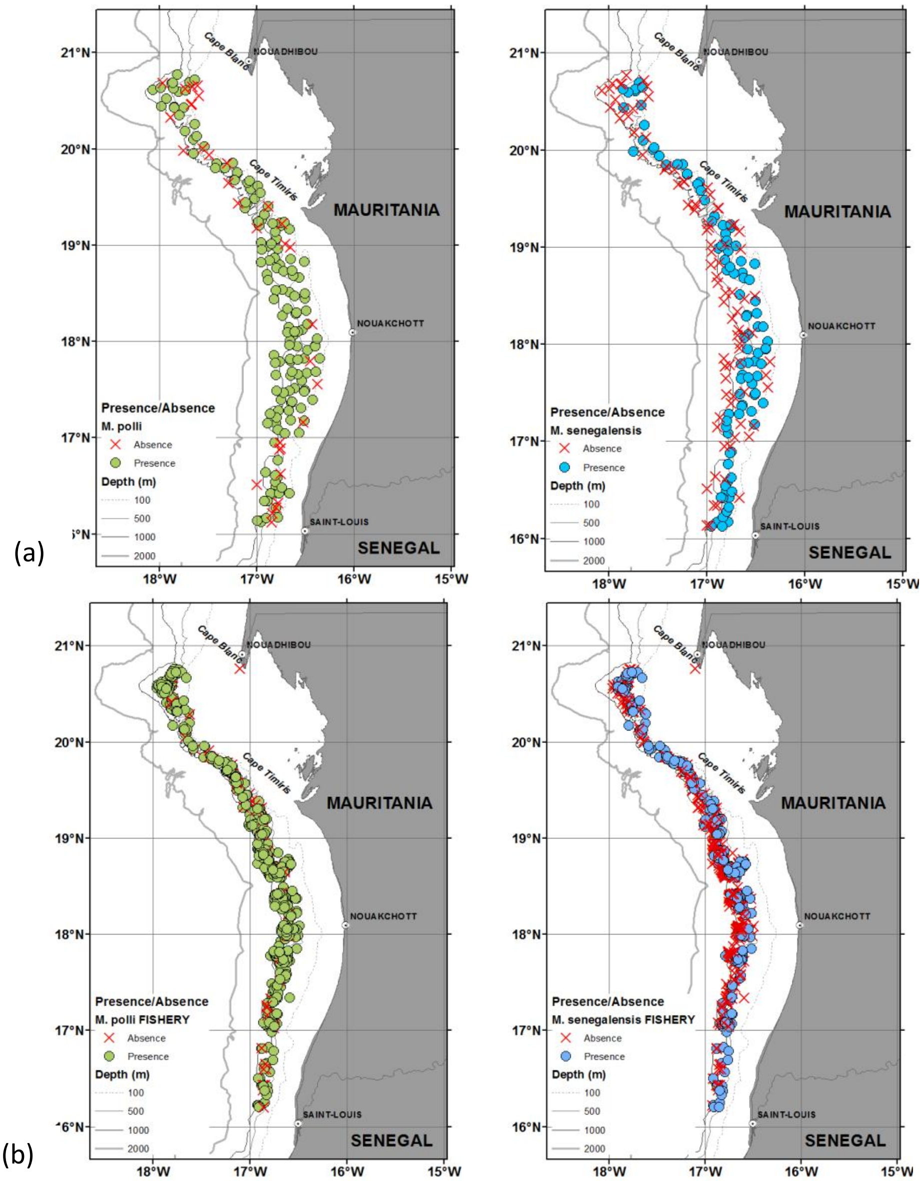

Figure 1. Study area, hauls without hake catch (red crosses) and presence/absence of *M. polli* (green circles) and *M. senegalensis* (blue circles) in scientific surveys (a) and commercial fishing trips (b).

M. polli was very frequent: captured in 98% of the sampled commercial hauls and in 83% of the survey hauls. *M. senegalensis* appeared in 41% and 52% of the sampled commercial trawls and research surveys, respectively.

Haul distribution

Over 50% of the commercial hauls were made between 400 and 600 m (Figure 2), with more than 40% of them made around 18° N. Little prospection was carried out above 100 m, since only 3 hauls in commercial ship and 22 in the surveys were made in shallower waters. For this reason, our results in waters above 100 m cannot be considered as reliable as those obtained for deeper waters.

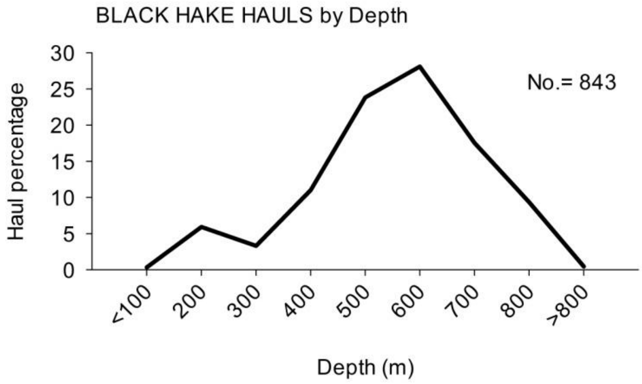

Figure 2. Frequency of commercial trawls by depth range.

More than 55% of the hauls analyzed were performed between April and August, a period with the lowest yearly average depth by trip (467 m), as shown the Figure 3. The less sampled months were March (only 6 hauls), and September (26 hauls).

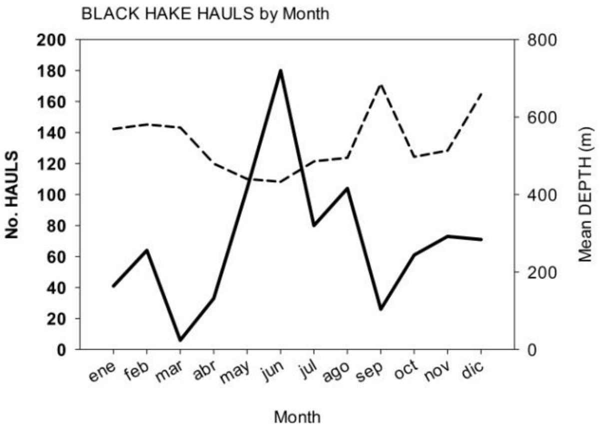

Figure 3. Haul distribution and haul average depth in commercial vessels over an annual cycle. Number of hauls (solid line). Mean depth (m) (dashed line).

Average yields by depth range

Figure 4 shows the bathymetric distribution of yields for both black hake species obtained from research surveys (a) and commercial vessels (b). At similar depths, hake yields were higher for commercial hauls (Figure 4 b) (almost twofold for Senegalese hake) than those obtained during scientific cruises (Figure 4 a). However, the bathymetric yield distribution of the two species followed similar patterns. *M. senegalensis* had a narrower bathymetric distribution than *M. polli*. Adults of *M. senegalensis* were fished between 100 and 500 m, peaking between 100 and 400 m (average values of 72 kg/h and 32 kg/h in commercial fishing and surveys, respectively) and abruptly falling below 500 m depth to around 3 kg/h in commercial fishing and 0.35 kg/h in research surveys. Senegalese hake almost disappears below 600 m depth, where only isolated specimens were captured at a maximum depth of 713 m in commercial hauls and 660 m in surveys. *M. polli* had a larger bathymetric range, occurring from above 100 m to approximately 1100 m (1098 m and 1065 m, as maximum recorded depths in commercial hauls and surveys, respectively), with important fishing yields in almost the entire depth range, from 100 m to more than 800 m (where yields attained 100 kg/h). *M. polli* maximum yields were achieved between 200 and 600 m, being higher in commercial hauls (over 250 kg/h on average) than in the research surveys (135 kg/h) while minimum values were found between 600 and 700 m for both datasets, even if more markedly for surveys.

Both black hake species showed poor average yields in waters above 100 m, for surveys and commercial trips (10.20 kg/h), but these results were excluded from the analysis (Figure 4). Curiously, Senegalese hake was only present in 9 of the 22 hauls made in this shallowest stratum, while the Benguela hake was captured in 14 hauls.

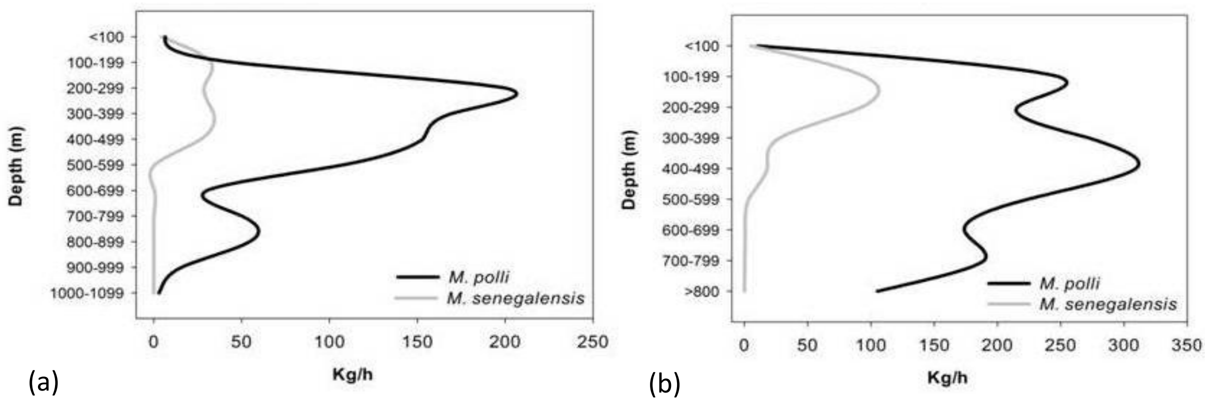

Figure 4. Bathymetric distribution yields (kg/h) of *M. senegalensis* and *M. polli* in scientific surveys (a) and in commercial fishing trips (b).

Figure 5 shows the bathymetric distribution of yields for the retained and discarded fractions of both black hake species (commercial fishing data). In the retained fraction (adults), yields were maximal (70 kg/h) for *M. senegalensis* between 200 and 300 m, and between 300 and 800 m for *M. polli* (200 kg/h on average). No specimens of *M. polli* were retained in shallow waters (above 100 m), because they were undersized (<35 cm) and thus discarded (Figure 5 a). Discards were maximum for both species between 100 and 300 m, although *M. polli* was almost four times more discarded (> 200 kg/h on average) than *M. senegalensis* (around 45 kg/h), the shallowest species.

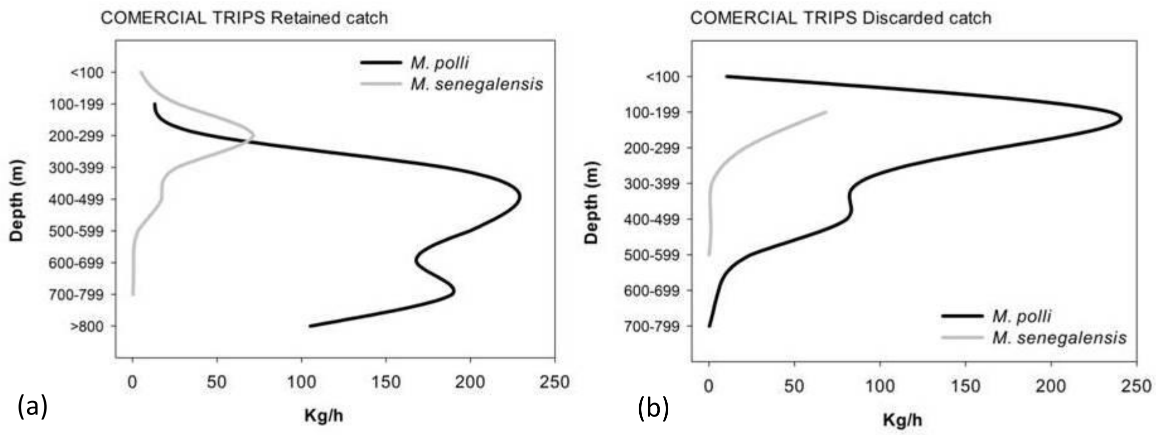

Figure 5. Bathymetric distribution yields (kg/h) of *M. senegalensis* and *M. polli* in the retained (a) and discarded (b) catch from commercial sampled trips.

Specimens of *M. senegalensis* fished above 100 m depth have legal sizes (>MLS) and are thus not discarded. There are almost no discards of *M. senegalensis* below 400 m depth and below 700 m for *M. polli, even if* this last species is still discarded at that depths (6kg/h on average) (Figure 5 b).

Proportion of species per bathymetric stratum

Figure 6 shows that the greater part of the catch is composed of *M. polli*, whose percentages ranged between 61% (survey data) and 68% (commercial trips) in waters up to 100 m, depth at which *M. senegalensis* is most abundant. *M. polli* reaches up to 99% from 500 m in both types of studies, almost completely disappearing Senegalese hake around 700 m depth.

In surveys, maximum overlap of the two hake species occurred between 100 and 200 m, where the percentages of *M. senegalensis* and *M. polli* were of 40% and 60%, respectively (Figure 6 a). In commercial trips, maximum overlap occurred between100 and 300 m, where these percentages were 30% (*M. senegalensis*) and 70% (*M. polli*) (Figure 6 b). For the whole area, the ratio *M. polli*:*M.senegalensis* was 7:1, the same for commercial trips and research surveys but varied with depth in both cases. Up to 300 m this ratio was found to be 4:1 (surveys) and 5:2 (commercial trips), favourable to Senegalese hake, but below 300 m the ratio became 16:1 and 11:1, and from 600 m were captured 620 kg of Benguela hake in commercial trips and 560 kg in campaigns in an hour for only 1 kg of Senegalese hake.

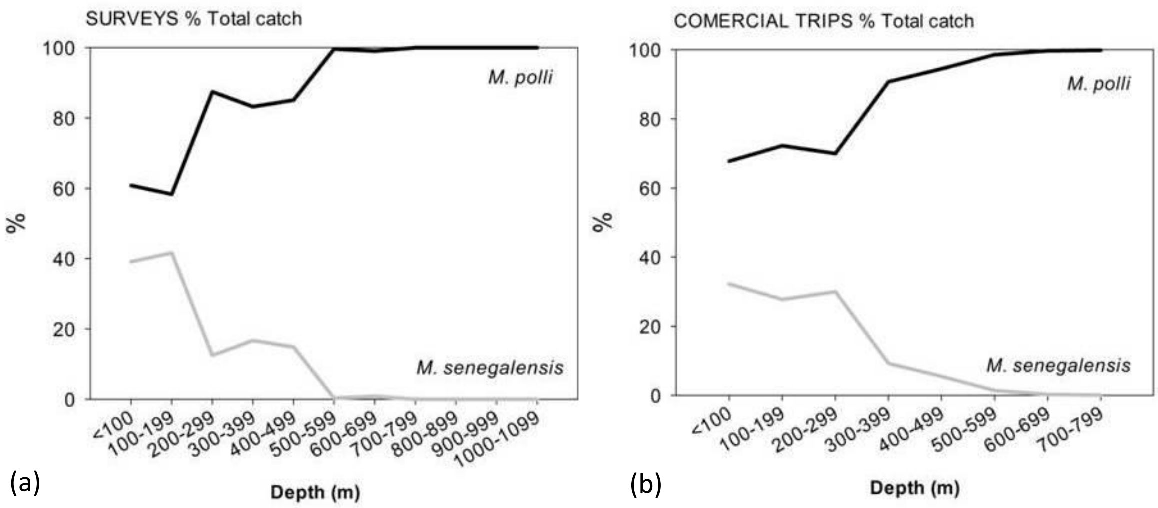

Figure 6. Proportion of *M. polli* and *M. senegalensis* in hake catch per bathymetric strata. Scientific surveys (a) and commercial trips (b).

Since the abovementioned proportions of species (Figure 6) are not really represented in landings, we have calculated these percentages for the retained and discarded fractions of the commercial catches (Figure 7).

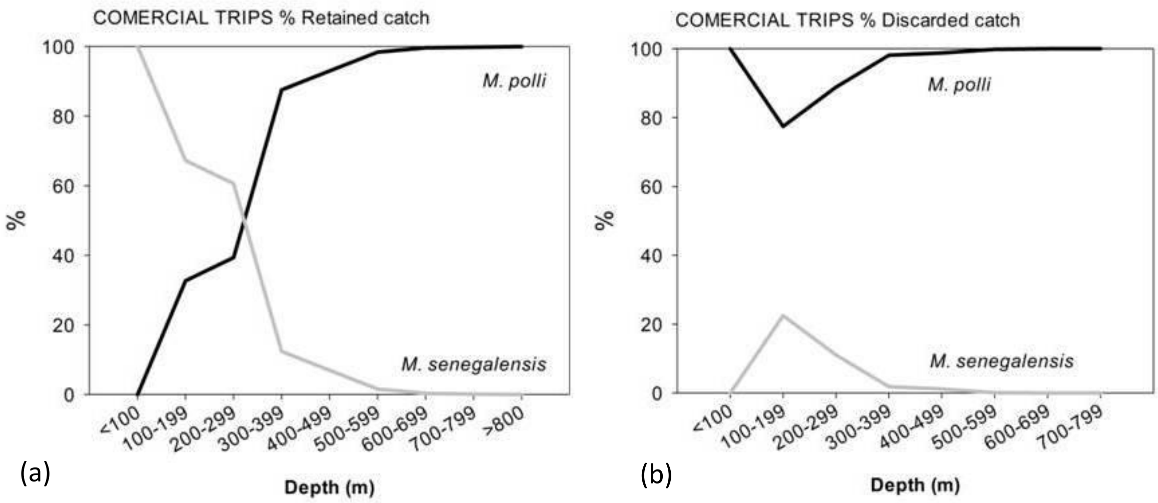

Figure 7. Proportion of *M. polli* and *M. senegalensis* in retained (a) and discarded (b) catches of the sampled commercial vessels by bathymetric strata.

Figure 7 b shows that, for the whole bathymetric range, the discards were basically composed of *M. polli*, in waters up to 100 m, a stratum where only this species is discarded, and at depth more than 600 m, there were still some discarded sizes below 35 cm (around 50%) (Fernández-Peralta *et al.*, 2013, in this WG). *M. polli* accounted for 87% of the total discarded hakes, while discardings of *M. senegalensis* accounted for 23% and was mainly restricted at depths from 100 to 300 m, peaking between 100 and 200 m.

The bathymetric pattern of the retained specimens (marketable sizes) of both species, most of them reproductive adults, was very different. No catches were recorded for *M. polli* in waters above 100 m, because the entire hake catch was composed of *M. senegalensis*. Up to 300 m the presence of *M. senegalensis* adults is higher than those of *M. polli*, in a 2:1 ratio, but between 300 and 400 m, this ratio is reversed to 1:7 and, from 400 m, the entire catch was composed of *M. polli* adults. Therefore, the maximum overlap occurs between 200 and 400 m (Figure 7 a). Retained catch of *M. polli* accounts for 88% of the total hake fished in the area.

Latitudinal distribution of average yields

Figure 8 shows the average yields (kg/h) per degree of latitude in both black hake species. Yields were higher in the commercial trips than in surveys. *M. polli* was also the most abundant species throughout the area, with higher average yields (256 kg/h) in commercial trips than in surveys (95 kg/h) in the southern part of the study area, between 18 N -16°N, peaking at 17°N (more markedly in surveys,Figure 8 a). On the contrary, *M. senegalensis* was more abundant in the northern hauls of the commercial trips, between 20 N and 19 N (24 kg/h), and peaking at 17°N (16 kg/h) (Figure 8 b). In scientific surveys, *M. senegalensis* appeared homogeneously distributed from north to south, but recorded also maximum yields at 17 N (22 kg/h).

Figure 9 shows separately the retained and discarded fractions of commercial catches by degree of latitude, to analyze the distribution of yields of adults and juveniles in the area.

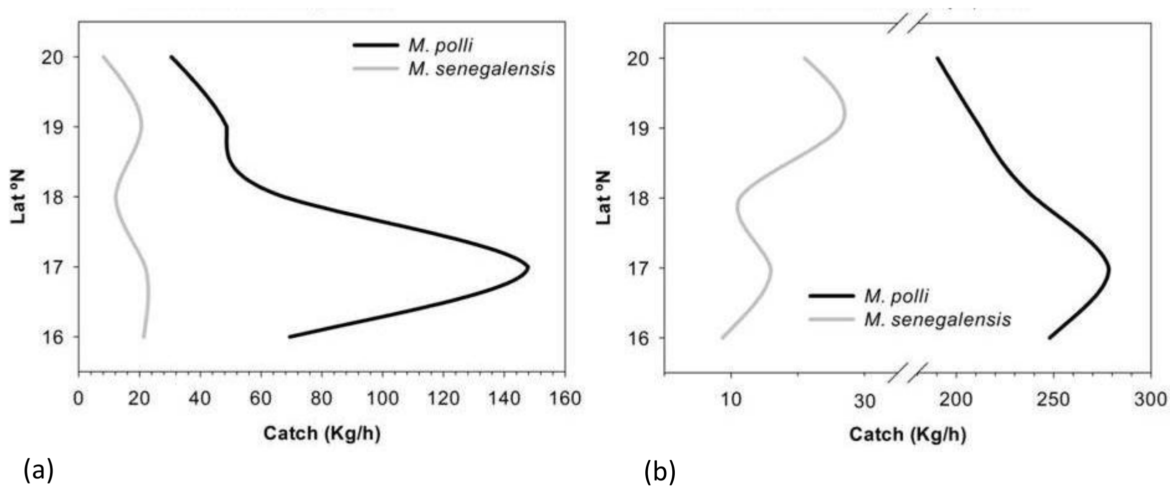

Figure 8. Latitudinal distribution of yields (kg/h) of *M. senegalensis* and *M. polli* in scientific surveys (a) and in commercial trips (b).

Adults of *M. polli* were much more abundant throughout the whole area than those of *M. senegalensis*, showing its highest concentrations in two peaks of 188 kg/h at 18 N and of 181 kg/h at 16 N. Curiously, *M. polli* adults were the less abundant at 17 N (Figure 9 a), coinciding with a high presence of juveniles of the species (Figure 9 b). Adults of *M. senegalensis* were more abundant in the northern area, between 20°N (16 kg/h) and 19 N (20 kg/h), and less abundant at 18 N (6 kg/h) and 16 N (7 kg/h), coinciding with low numbers of juveniles.

The coastal species, *M. senegalensis* showed low discard levels but constant in the whole area. For the Senegalese hake, the average discarding values were of 4 kg/h between 18° N and 16° N, and of 6 kg/h between 20° N and 19° N. The deepest hake, *M. polli*, was more discarded than *M. senegalensis*, especially at 17° N (122 kg/h), but also between 20° N and 18° N (34 kg/h).

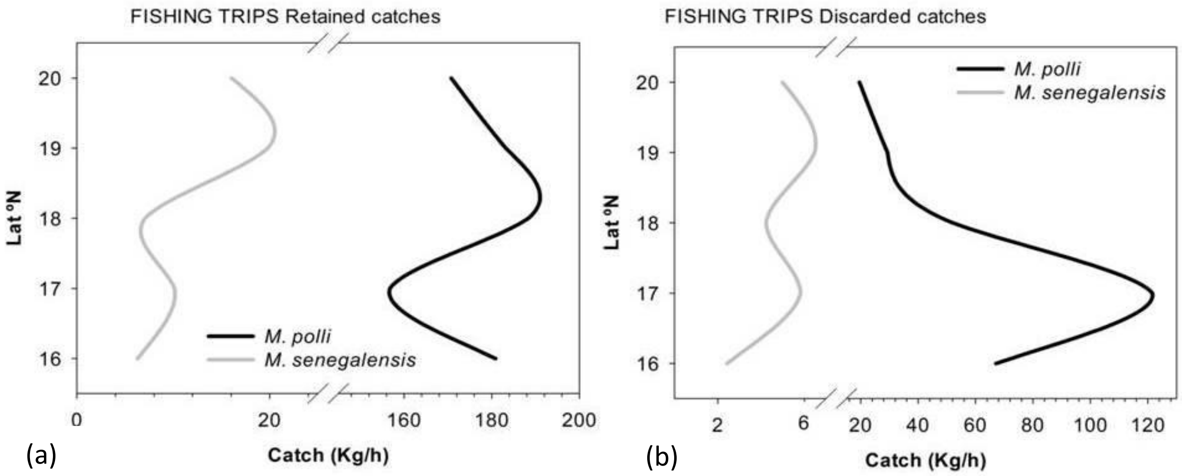

Figure 9. Latitudinal distribution of yields (kg/h) of *M. senegalensis* and *M. polli* in the retained (a) and discarded (b) catch from commercial sampled trips.

Monthly evolution of average yields

Figure 10 presents the monthly evolution of yields for both hake species. Throughout the whole year, yields recorded for *M. polli* were higher than those recorded for *M. senegalensis*. *M. polli* increased in abundance throughout the year, reaching the highest values (averaging 256 kg/h) at the beginning of the spawning season (September to December). *M. senegalensis* reached its maximum abundance (averaging 23 kg/h) from May to August, with also high abundances (averaging 17 kg/h) from October to December, and minimum yield values between January and April (averaging 2 kg/h).

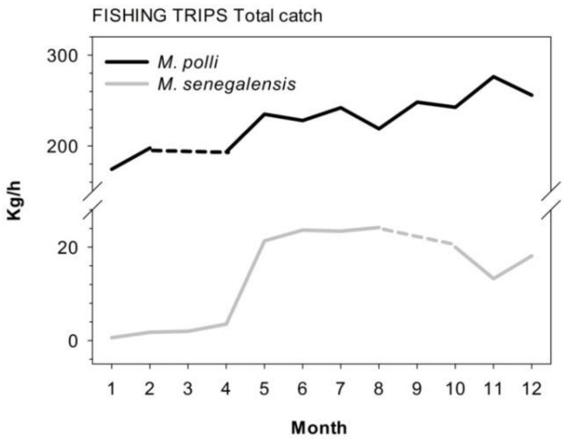

Figure 10. Monthly evolution of yields (kg/h) of *M. senegalensis* and *M. polli* in commercial sampled trips. Dashed line, are the months (March and September) not considered in the analysis.

Figure 11 shows the monthly variation of retained and discarded yields for both species. Abundances of *M. polli* adults and spawners decreased in summer (from June to August) and averaged 153 kg/h, while *M. senegalensis* adults and spawners were the most abundant between May and August and averaged 19 kg/h (Figure 11 a).

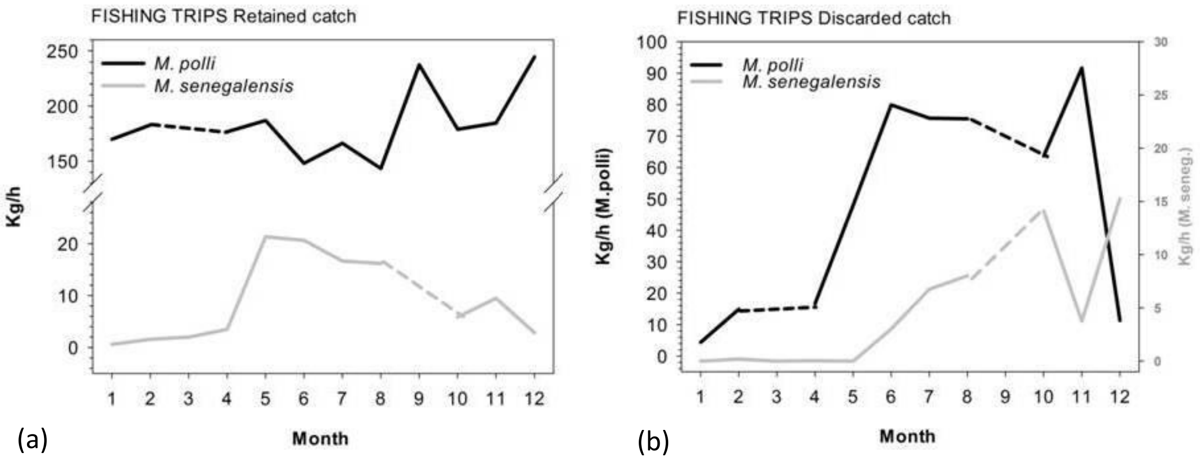

Figure 11. Monthly evolution of yields (kg/h) of *M. senegalensis* and *M. polli* in the retained (a) and discarded (b) catch from commercial sampled trips.

At the beginning of the year (between January and April), *M. polli* (the deep species) averaged yields of 180 kg/h, while *M. senegalensis* (the shallow species) achieved minimum yields of less than 2 kg/h. *M. polli* recorded the highest concentration of spawners (211 kg/h) at the end of the year (between September and December), while *M. senegalensis* yields decreased drastically to 6 kg/h (Figure 11 a).

Discarding of both species presented similar trends, as shown by Figure 11 b. Yields increased from May (*M. polli*) and June (*M. senegalensis*), remaining high until the end of the year, when discarded *M. polli* abundance dramatically decreased in December to 11kg/h. This species showed higher discards in October and November and between May and August (averaging up to 70kg/h on those months), compared to the *M. senegalensis* discarded yields of 6kg/h between June and August. Senegalese hakes were mainly discarded (about 15kg/h each month) in October and December. Both black hakes showed minimal discarding values at the beginning of the year, even if they were not negligible for the Benguela hake.

DISCUSSION

The observed differences between the two data sources (research surveys and sampled commercial trips) are due to the different sampling periods considered: the surveys were always conducted from mid-November to mid-December and therefore reflected hake populations at the beginning of their spawning peak, while commercial fishing data were obtained to cover a year. However, both datasets allowed for incorporating a high number of hauls in our calculations, ensuring the robustness of the results. In addition, the yields estimated in this study are consistent with the CPUEs of the two species mixed in the landings.

Both black hake species showed different and opposite bathymetric, latitudinal and monthly distributions of their abundances, which is in agreement with the GAM modelling study performed using data from commercial fishing. The study of Quintanilla *et al.* (2013) has analyzed how these variables influence the distribution and abundance of the two species.

Our results evidenced that *M. senegalensis* is neither present nor abundant in Mauritanian waters below 100 m depth, while *M. polli* is more frequent and abundant, being the hake dominant species in the study area. *M. polli* is seven times more abundant than *M. senegalensis* in these bottoms, and accounted for around 90% (average) of hake catches.

M. polli is broadly distributed in space and depth (Lloris *et al.*, 2003), with very high yields around 800 m. Its bathymetric limit is set to 1100 m, a fact not described until now and corroborated by research surveys (Fernández-Peralta et al., 2011). On the contrary, *M. senegalensis* has a shallower distribution, with minimum yields at 500 m, and totally disappearing at approximately 700 m. Senegalese hake must live in very shallow bottoms, as suggested by the low discarding yields in waters up to 100 m. This bathymetric segregation of black hake species has been cited previously (Boukatine, 1986; Caverievière *et al.*, 1986; Wysokinski, 1986;, López-Abellan y Ariz-Tellería, 1993) but has been poorly studied.

The highest concentrations of both species, besides taking place at different depths and latitudes (*M. polli* at 18°N - 17°N and 300-500m, and *M. senegalensis* at 20° - 19°N and 100-300m), occurred also at different periods of the year, influenced by the hydrological regime (Zenk, 1991; Anonymous, 2002; Peña-Izquierdo *et al.*, 2012). The shallow-water species was more abundant from May to August, during the cold-to-warm transition and warm hydrological seasons. The deep-water species was more abundant from September to December, coinciding with the warm-to-cold transition and cold seasons Regardless of *M. polli* always recording the highest yields throughout the year, we observed that low yields of one species corresponded to high yields of the other species.

The higher frequency of occurrence of *M. polli* observed in commercial trips (98%) compared to those of scientific surveys (83%) may be due to fishing strategy differences, since 80% of the commercial hauls were mainly performed between 400 and 800 m, where is located a large part of its population and only a few large spawners of *M. senegalensis*. As the surveys were conducted through the spawning season, *M. polli* specimens were probably less present in the study area due to a southward reproductive migration of this species, to Senegalese waters (García, 1982; Caverivère, 1986; Wysokinski, 1986; Sobrino *et al*., 1990; Fernández-Peralta *et al.*, 2007; 2008; 2009; 2011).

The abrupt decrease of Senegalese hake large individuals (retained fraction) in the spawning season, and especially in the first months of the year, may be due to several reasons: they are present in areas inaccessible to trawls (such as canyons heads very frequent, especially northward); they are present in not prospected shallow waters, above 100 m; the main spawn event takes place outside Mauritanian waters, perhaps in Saharan waters, north to Cape Blanc (Maurin, 1954; García, 1982; Wysokinski, 1986; Fernández-Peralta *et al.*, 2011). Instead, the summer decrease of adults/spawners individuals of Benguela hake, between June and August, may be due also due to different reasons: a bathymetric migration to avoid warming waters (Caverivière, 1986; Dah *et al.*, 1991), or a bathymetric migration to deeper bottoms not fished by trawlers in these months.

Our study highlights the low presence of *M. senegalensis* in the study area, when historically this species achieved the highest yields and their proportion in catches used to be higher than those of *M. polli.* In the past, *M. polli* was considered in Mauritania as a secondary species. Previous studies (FAO 1978; Boukatine 1986; Bourdine 1986; Overko *et al.* 1986; Cervantes and Goñi, 1986; Wysokinski, 1986; Sobrino *et al.* 1990; Ramos *et al.*, 2001) recorded that *M. senegalensis* accounted a range from 80% to 100% of the catches, reaching its maximum especially in the northern waters off Mauritania, and even at great depths (400 to 500 m.). In fact, *M. senegalensis* was then considered as being the dominant hake species in the area. *M. polli* only achieved high yields through the winter in southern waters and between 400 to 600 m (Boukatine, 1986). *M. senegalensis* always showed higher proportions than *M. polli* in this study. In fact, even in official fisheries statistics, all black hake catches were attributed to *M. senegalensis*. Sorting two species morphologically resemblance and fished in large quantities has been a difficult task of our study, as usually happens in other hake mixed species' stocks (Botha, 1985; Bezzi *et al.,* 1995; Aguayo-Hernández, 1995; Gordoa *et al.,* 1995; Tingley *et al*., 1995; Arkhipkin *et al.*, 2003). In many cases, black hakes are recorded as *Merluccius* spp., even in the scientific surveys (Overko *et al.*, 1986; Anonymous, 2002.). Doubtless, *M. senegalensis* was in the past more abundant in Mauritanian waters, as could be seen in the fish market of Cadiz, the main landing port, where hake accounted for 61 % of landings, in 1988.

Recent studies, based on experimental data collected onboard experimental longliners, *M. senegalensis* showed percentages above 80% in the overall catch (Ramos *et al.*, 2001), although this highly selective fishery captures black hakes probably on the edge of canyons, where Senegalese hake seems to be concentrated (Fernández-Peralta, comm. pers.), and like it occurs in other hakes (Recasens *et al*., 2008). In posterior longline surveys carried out throughout one year (2003 to 2004), and systematically covering depths between 80 and 100 m, *M. polli* was more abundant in the catches, accounting for 54% of the fished hakes (Ramos, 2004; Fernández-Peralta *et al.*, 2006; Fernández-Peralta, 2009). Data from observers onboard commercial trawlers were also collected from 2003 to 2004 and showed specific proportions close to those found in this study (Fernández-Peralta *et al.*, 2006; FAO, 2010): *M. polli* accounted for 67% in summer but almost reached 100% in winter, although the winter fishing hauls were always carried out below 500 m.

This study arises one question: is there a decline in the abundance of *M. senegalensis?*

Our results clearly show a dominance of *M. polli* in all bathymetric strata, even in the shallow waters typically preferred by *M. senegalensis,* which invalidates the idea of Senegalese hake being less abundant because the sampled hauls were performed at deeper bottoms than in precedent studies. Longline fishery data have shown that *M. senegalensis* is often found in untrawlable bottoms, but this black hake species has always been an abundant species to 500 m, as demonstrated by the first demersal trawl surveys carried out and as inferred from demersal trawlers black hake fishery data series.

The low abundance values recorded in our study for *M. senegalensis* in Mauritanian waters could be due to a northward shifting of both species, which could be concentrating in Saharan waters (non sampled for this study and where these species are actually not commercially exploited). Since *M. senegalensis* has a distribution area more extended to the north (33°N) than *M. polli* (25°N) (Lloris *et al.*, 2003; Fernández-Peralta *et al.*, 2011) the Senegalese hake could be favored to achieve higher yields in these fishing grounds (García, 1982; Bourdine, 1986).

Historically, *M. senegalensis* has undergone higher fishing pressure than the deep-water hake species. In fact, this species has been exploited for decades, not only by fleets targeting the Senegalese hake but also by many fleets fishing on the continental shelf and capturing high numbers of juveniles in waters above 100 m, as well as large spawners in deeper areas.

M. senegalensis feeds on Carangidae, Scombridae and Clupeidae families (Fernández- Peralta *et al.*, 2008) which are also heavily exploited in the area and record significant fluctuations in their populations, a fact probably affecting the abundances of Senegalese hake (Gucu and Bingel, 2011). This species lives in an environment more changeable compared to the slope, where inhabits *M.polli*, a fact also affecting somatic and physiological status of Senegalese hakes, much more variable and less favored than the deep-water hake (Rey *et al.*, in press). Thus, Senegalese hake is probably a more vulnerable species whose presence and abundance have declined over the last decade as a result of fishing activity, among other causes. As evidenced by its wide geographic and bathymetric distribution, *M. polli* is perhaps a more versatile and adaptable species being able to occupy the ecological niche of its sympatric shallow-water species. In this competition, *M. senegalensis* could be disadvantaged by the highest fishing pressure endured and its great sensibility to environmental conditions, two possible explanations for the decline of its populations in Mauritanian waters.

To assess if there is a truly decline of *M. senegalensis* populations, studies on the populations of both hakes, especially in Saharan waters where they are now unexploited, must be continuously implemented and carried out. These studies are crucial to monitor their abundances and to define the ecological role of each species in the region.

The preponderance of *M. polli* over *M. senegalensis* in the commercial catches of the bottom-trawl fleet in Mauritanian waters justifies the management and assessment of this fishery as a single-species stock.

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