Scientific Advice for Fisheries Partnership Agreements

DEMERSAL FISH (HAKE, OTHER FINFISH AND ELASMOBRANCHS) STOCKS EXPLOITED BY THE EUROPEAN FLEET UNDER FISHERIES PARTNERSHIP AGREEMENTS SIGNED WITH MOROCCO, MAURITANIA AND GUINEA-BISSAU

Lourdes Fernández Peralta
Javier Rey and
Miguel Ángel Puerto

20 June 2011

CONTENTS

INTRODUCTION

1. Description of the fishing grounds

1.1 Morocco

The Moroccan Atlantic coast is part of one of the four major trade-wind driven continental margin upwelling zones in the world, the North-Wwest African upwelling system (or the Canary Current System). It is under the influence of the subtropical system of high-pressures of the Açores and the system of low-pressure zone known as the Intertropical Convergence Zone (ITCZ). Several authors place the ITCZ off Western Sahara and Mauritania, between the North Atlantic Central Water (NACW) and South Atlantic Central Water (SACW) (Manríquez and Fraga, 1982; Barton, 1985; Fraga *et al.*, 1985; Kearns and Carr, 2003; Martínez-Marrero *et al.*, 2008, García-Isarch *et al.*, 2010).

The Moroccan Atlantic continental shelf is generally narrow, between 40 and 60 km wide (Wynn *et al.*, 2000a), although maximum shelf widths between 100 and 120 km occur north and south of Cape Blanc (Seibold & Fütterer, 1982). The Moroccan continental margin is affected by energetic winds and currents that transport sediments seaward and along the continental margin, north of 30º N (Wynn *et al.,* 2000a, Ramos *et al.*, 2005).

Along the North-Western coast of Africa, surface transport is driven by currents that are usually equatorwsrd: the Canary Current (0-600 m depth) and the Guinea Current. Under this surface layer, a poleward counter-current, situated near the edge of the shelf, sinks progressively from the Bay of Biafra (where it is still a surface current) to Morocco, progressively reducing its speed. In Moroccan coasts, the core of this poleward circulation is located between 200-300 m off Cape Blanc, 400-500 m at 25º N, and 500-1000 m between 30º N and 34º N. (Mittelstaedt, 1982 and 1983). During periods of locally weak winds, the submarine north current can reach the surface and to spread on the continental shelf (Clarke, 1989; Mittelstaedt, 1991; Knoll *et al.*, 2002).

In the Eastern Central Atlantic, the dynamics of an eastern boundary current interacting with trade wind-driven upwelling control this marine ecosystem with exceptionally high primary and secondary productivity (Cury and Roy, 1989; Binet, 1997; Demarcq and Faure, 2000; Fraile-Nuez *et al.*, 2010). To the south of Cape Blanc (21º N) the coastal waters are constituted predominantly by SACW (rich in nutrients and low salinity) rising to the surface from 100-200 m depth. North of Cape Blanc the emerging waters from 200-300 m depth belong to NACW (less rich in nutrients and more saline). Both water masses are originally of the subsuperficial type, and their upwellings are separated by a clear transition area off Cape Blanc (Raspberry, 1974; Tomczak Jr., 1978; Manríquez and Raspberry, 1982), and corresponding to a termohaline front (Elmoussaoui *et al.*, 2003).

While coastal upwelling occurs mostly on the shelf, biogenic particles derived from upwelling are deposited mostly in the upper continental slope. Nutrient-rich coastal waters are transported within the Cape Ghir filament region at 30° N up to several hundreds of kilometres offshore. Both upwelling intensity and filament activity are dependent on the strength of the summer trade winds (Freudenthal *et al.*, 2002).

West of Cape Ghir there is one of the most important filament formation areas of the Moroccan coast, because it is a semi permanent phenomenon. It is particularly intense in summer and autumn and can extend offshore over several hundreds of kilometres (Camp *et al.*, 1991; Nykjaer and van Camp, 1994; Hagen *et al.*, 1996; Hernández-Guerra and Nykjaer, 1997; Barton *et al.*, 1998). The formation and spread of the filaments might contribute to the circulation of the organic matter, the

larvarian transport, and to the energy transfert from the deepest strata of the water column to the open ocean (Becognée *et al.*, 2009).

The Moroccan sub-region between Cape Sim and Cape Blanc, which benefits from the upwelling throughout the year, is biologically very productive and sustains one of the main fishing areas of the world, because it benefits from a high mesoscale oceanographic variability arising from its geographical heterogeneity: variations in shelf width, the presence of major capes and the perturbation represented by the Canary Islands produce extended filaments and island-induced eddies (Arístegui *et al.*, 2009).

1.2. Mauritania

Mauritania has nearly 720 km of Atlantic coastline, with a 200 mile exclusive economic zone (EEZ) extending from 20° 36' N (southern limit of Western Saharan waters, near Cape Blanc) to 16° 04' N (northern limit of Senegalese EEZ, at the Senegal River mouth). The EEZ surface is of 234 000 km^2 of which approximately 16% (39 000 km2) are over the continental shelf. This continental shelf is around 40 miles wide near Cape Blanc, attaining its maximal width (80 miles) in front of the Arguin Bank (between Cape Blanc and Cape Timiris). South Cape Timiris, the shelf reduces to a minimum of 30 miles wide.

Therefore, two areas can be clearly separated, north and south Cape Timiris (19º 21' N), where the 200 m isobaths are as near as 10 miles from coast (Sobrino and García, 1992).

In general, bottoms are not very rough, with dominance of sandy and sandy-muddy sediments. Mud and rocky bottoms are not very spread, although some longitudinal rocky banks are located near the southern coast of Cape Timiris. The shelf edge at SW of Cape Timiris is characterized by a number of underwater rocky valleys and canyons separating areas of 10 m depth from others of 300-400 m depth (Sobrino and García, 1992).

The Mauritanian coast is part of one of the four major trade-wind driven continental margin upwelling zones in the world oceans, the northwestern African upwelling system (or the Canary Current System). In the Eastern Central Atlantic, the dynamics of an eastern boundary current interacting with trade wind-driven upwelling controls this marine ecosystem with exceptionally high primary and secondary productivity (Cury and Roy, 1989; Binet, 1997; Demarcq and Faure, 2000). The region off Mauritanian coasts is part of this coastal upwelling ecosystems characterized by seasonal or permanently strong equatorial winds. A persistent wind-induced offshore drift of the surface waters tends to advect particles from the coastal environment and generate upwelling of deep, nutrient-rich water (Wooster and Reid, 1963; Brink, 1983). In the northern part of Mauritania, the trade winds blow from early winter to late spring (October to June), generating strong seasonal upwelling, whereas north of Cape Blanc (20°-25° N), upwelling is quasi-constant, with periods of stronger intensity. However, upwelling lasts around nine months off Nouakchott. Large seasonal and yearly environmental variations in such areas are mainly caused by fluctuations in upwelling, which induce changes in productivity and availability of food, sea temperature and water column stability.

Both annual and seasonal fluctuations of upwelling intensity, wind-induced turbulence, and coastal retention show the strong temporal instability of the environment in the Mauritanian upwelling area (Faure *et al.*, 2000). The upwelling season starts in October, reaching maximal intensities from January to May and minimal values around September. The coastal retention phenomenon is minimal in January and maximal from April to June. In autumn, despite an increase in upwelling intensity, cold-water intrusions onto the Arguin Bank induce a large reduction of the coastal retention index. Such inshore water movement occurs only towards the end of the upwelling season when westerly winds dominate, suggesting that the direction and intensity of the wind must be a

limiting factor for inshore water penetration on the bank. The intrusion of cold water may enhance productivity over the bank as the upwelled waters are advected onto the Arguin Bank and supply the nursery area with nutrients. For the remainder of the year, variations in coastal retention mainly reflect the sea surface temperature fluctuations because of upwelling variations or changes in light intensity. Maximal values of wind-induced turbulence are observed from April to June and minimal values in November and December.

The marked seasonality of upwellings and their latitudinal displacement off Mauritanian and Senegalese coasts produce important changes in the structure of the biological communities. The system can then switch in short time periods (weeks) from a warm equatorial phase to a cold subtropical phase, thus provoking an alternating dominance of tropical and temperate communities (Meiners, 2007a).

1.3. Guinea-Bissau

The Guinea-Bissauan EEZ is located between Senegalese (at north) and Guinean waters (at south). Its marine ecosystem is strategically situated between two large marine ecosystems (LME): the southern limit of the Canary Current LME and the western limit of the Guinea LME, both being considered as highly productive (Heileman, 2009; Heileman & Tandstad, 2009). In the tropical West African region, the combination of a number of climatic and hydrologic factors contribute to the existence of an exceptional environment, even more marked in Guinea-Bissau due to the great extension of its continental shelf, which has encouraged the presence of foreign industrial fleets for decades. The Guinea-Bissauan continental shelf is the largest in Western Africa, with a width of more than 75 miles in the north, 60 miles in the south, and an extension of about 10 800 m2 (García-Isarch *et al*., 2009). In the southern area, the shelf reduces its extension to an effective width of 30 miles due to the presence of the Bijagos Islands. The coasts are deeply cut out by the numerous rivers that open into the sea in this area (Domain, 1980). It contains one of the biggest estuarine areas and one of the most extensive mangrove zones in West African coastal waters (Binet *et al.*, 1995).

Three main zones can be distinguished depending on the sediment´s nature and bathymetry. There is a shallow area (20-75 m depth), with soft bottoms (mud and sand) in the northern area (mainly related to the river mouth), and with hard bottoms from Bijagos to the Guinean border in the south, externally associated to coral reefs and crossed by numerous submarine canyons and valleys (McMaster *et al.*, 1971). At bottoms deeper than 200 m, deposits vary from soft (mud and sand) to hard (rubble, gravel, and rocks). At depths between 400 and 600 m, sediments are all soft.

The Guinea-Bissau ecosystem is characterized by strong seasonal variations of oceanographic conditions (Berrit & Rebert, 1977), with higher productivity during the dry season (Longhurst, 1983) due to the upwelling events that mainly occur from January to February. Characteristically warm and salty tropical waters dominate from May to June. With the progression of the rainy season, the intrusion of warm, low salinity inner waters tend to dominate. As a result of upwelling events and the input of organic matter from river run-off, primary productivity is relatively high in the area (Berrit & Rebert, 1977). The coastal areas are also under the influence of strong currents and occasional strong winds. The biota have adopted strategies compatible with this variability, as reflected, e.g., in feeding migrations of fish along the coast and the reproductive migration of shrimp into estuaries following the cycle of wet and dry seasons.

2. Hake fisheries in North West African waters

Along the 20th century, hakes have been one of the most heavily exploited demersal finfish groups in Eastern Central Atlantic (FAO, 1978, 1986 a, 1997).Three hake species coexist in the area, even if their proportions and sizes in the catch differ between the different fishing zones due to the particular latitudinal distribution of each one. European hake, Merluccius merluccius (Linnaeus, 1758) is found in Moroccan waters. Senegalese hake, Merluccius senegalensis Cadenat, 1950 is distributed both in the central and southern zones of Moroccan waters, and in Mauritanian waters. The distribution range of the Benguela hake, M. polli Cadenat, 1950, overlaps with the distribution range of the another two Merluccius species in West Sahara, and is found to Guinea-Bissau, but is mainly fished in Mauritanian waters.

In Central Eastern Atlantic waters, the Spanish wet-fish trawl fleet was the first one to harvest hake species in Moroccan waters, targeting both European hake and deep-water rose shrimp. This wet-fish fleet was replaced by units only targeting European and Senegalese hake, at least in certain seasons, and using set gillnet ("*volanta*"), bottom longline and trawl 60 mm ("*trio*") in Moroccan fishing grounds. In the 1960s, the technological advances allowed the Spanish vessels to operate in southernmost waters, off Sahara, Mauritania and Senegal. This fleet specialised in the fishing of black hake species (*Merluccius polli* and *M. senegalensis*) with bottom trawls and, more recently, with bottom longlines. All these vessels used ice for catch preservation due to the vicinity of the landing ports. However, in certain seasons and depending on the fishing agreement conditions, certain units were authorized to freeze their catch when fishing in remote fishing areas of Mauritania and Senegal, even if the fishing strategies of those vessels were totally different from the abovementioned. The most recent detailed information from these fisheries is available in Ramos and Fernández, 1992; Ramos and Fernández, 1994; Ramos and Fernández, 1995; Fernández *et al.*, 1998; Ramos *et al.*, 1998; Diop *et al.*, 2004; Ramos *et al.*, 2000; Fernández *et al.*, 2004.

Other European fleets have been also operating in North West African waters, such as the polyvalent portuguese vessels, initially much more numerous and from which fisheries data time series date back to the 1960s and some Italian and Greek trawlers coming for fish occasionally or intermittently.

In addition to these European directed fisheries, some of them nowadays nonexistent, hake species have been harvested by directed domestic fleets of the bordering countries. Also, hake species are fished as by-catch (sometimes in significant volumes) by domestic and foreign fleets of shrimpers, cephalopod trawlers, pelagic, or artisanal vessels. The Russian industrial fleet of pelagic and demersal trawlers, operating in the area along the 1960s and 1970s is the most significative example of foreign fleet achieving large by-catch of the three *Merluccius* species until 1977 (FAO 1986).

The management of hake stocks is very complicated because they are shared by different countries and jointly harvested by diverse fishing fleets using various types of gears at different depths and seasons.

The Spanish fleet has been the main European fleet targeting hake species, and the unique fleet constantly operating in the region, even if at some periods other foreign fleets (from the former URSS or Portugal) have been achieving significant catch. The activity of all the European fleets targeting hake in Moroccan waters ceased when the fishing agreement came to an end in 1999, and only the vessels operating in Mauritania and Senegal were allowed to fish for hake. In 2007, the new fishing agreement signed with Morocco allowed the catch of black hake species in fishing areas located south from 29 N, but this fishing modality has been underused, and in 2010 there was not any vessel. This fact, together with the end of the fishing agreement with Senegal (in 2006), reduced the directed fisheries currently targeting hake species to a few European (Spanish) trawlers operating in Mauritanian waters, and to Moroccan fleets fishing for European hake in domestic

waters. Hake by-catch of the multiple fleets operating in the whole area is another and non negligible harvesting factor to bear in mind.

2.1 Morocco

In November 1999, the end of the fishing agreement EU-Morocco meant the cessation of the activities of the whole European fleet (mostly Spanish and Portuguese) harvesting hake species in waters under Moroccan jurisdiction, according to the stipulated clauses of the successive agreements. Initially composed of 500 vessels, this fleet progressively decreased as time went on, and when the fishing agreement came to an end the number of vessels was under 100. Twenty years later, this fleet had disappeared and has not currently been replaced by any UE fleet targeting European hake in Moroccan waters, because there is no fishing modality for this species under the renewed UE-Morocco fishing agreement (COUNCIL REGULATION (EC) no 764/2006[1].)

The hake fishery in Morocco is carried out either by directed fleets targeting these species or by other fleets that capture them as by-catch. Directed fleets are both artisanal units of Moroccan coastal trawlers and longliners, and industrial Spanish trawlers catching black hake species. Hakes are also caught as by-catch by Moroccan freezer trawlers and by some multi-purpose units, but we do not have this information. The last Spanish trawler left Moroccan fishing grounds in 2010, but the main characteristics of this fleet are presented because there is still possible to incorporate a new unit this year.

Moroccan hake fleets

In the 1960s, a coastal Moroccan fleet of mixed-species trawls started the fishing for European hake *M. merluccius* and the deep-water rose shrimp *Parapenaeus longirostris* (Lucas, 1846), nowadays still operating. Currently, the Moroccan fleet is composed of small coastal vessels, trawlers and low range longliners harvesting European hake and deep-water shrimp over the continental shelf and landing their catch hold fresh in ice. These boats rarely fish in waters deeper than 150 m. The number of vessels in this category has remained quite stable since 1992 and around 450 units (FAO, 2006; FAO, 2007). Neither more complete nor recent data have been submitted to the last Working Groups on the resource. The trawling fleet operates mainly along the northern and central Moroccan coastline between Cape Spartel (36º N) and Cape Juby (25º N) (FAO, 1990; 2006). Nevertheless, as its activity is progressively extending southwards, the percentage of black hake species is increasing in the total catch since 2003. The average catch values for this trawling fleet from 2003 to 2008 was of 7650 t of European hake and 1009 t of black hakes. However, the associated yields are low (32 kg of European hake/fishing day in 2008), due to artisanal features of this fleet. As an average, trawlers are of 60 GRT, 400 hp and the fishing trips last from 1 to 5 days. Mesh in the codend is of 60 mm and there is no closed fishing season for biological rest of harvested species.

In 2001, a fleet of 22 wet-fish longliners operating as joint ventures and targeting European and Senegalese hakes and the pomfret (*Brama brama*). Catch data and features of this fleet are absolutely unknown, because Moroccan authorities are not exercising any kind of control nor monitoring by Moroccan authorities (FAO, 2010).

[1] Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Kingdom of Morocco (OJ L 141, 29.05.2006, p. 9–37)

In recent years (2008 to 2010) an average number of 28 joint venture longliners have been operating. They usually made 2 trips per month, of about 12-15 days each, mainly fishing for black hake and pomfret. Currently, 11 of these vessels continue fishing hake and pomfret, but also some vessel has switch to target deep-sea sharks as *Centrophorus* spp, and swordfish (*Xiphias gladius*) pushed by the low fishing yields and some commercial problems. As far as we know, this fleet may have achieved significant hake catches over the last 10 years, though they have never been reported.

As this fleet comes from the reflag of former Spanish longliners operating since the 1970s until the end of the agreement, their fishing strategy must be quite similar, although without the restrictive conditions and controls established in the early agreement (e.g. fishing ban inside 12 nautical miles). To have an idea of the average technical characteristics, we presented those of the former Spanish fleet operating until 1999. In that year, the average features of the 47 Spanish trawlers were: 79 TRB, 352 hp, and 22 m length overall. Catch was composed by 36% of European hake, 38% of pomfret, 17% of Senegalese hake and 10% of other species, for an average total catch of 2273 t per year (period 1989-1999). The fishing zone was very wide, with a large part of its annual effort (60%) concentrated north of parallel 30º 40' N (Ramos and Fernández, 1994).but extending its range southwards to reach the Mauritanian border in the last years of the UE-Morocco fishing agreement validity (Ramos *et al.*, 2000). In fact, in those years, the landings of Senegalese hake and pomfret increased greatly, attaining yields of 220 kg/fishing day and 420 kg/fishing day, respectively, being the yields of European hake and pomfret similar. The usual fishing depth ranged from 430 to 520 m when targeting hake, and 315 to 400 m when targeting pomfret.

European Union black hake fleets

The Spanish fleet, that has been harvesting hakes in waters off Western Sahara since the first quarter of the 20th century, has been reduced to a few vessels (2-3) in the last years of the former fishing agreement EU-Morocco, which expired in 1999, in favour of the most profitable fishing activity in Mauritania and Senegal.

In 2006, the new fishing agreement signed between the EU and Morocco authorized 22 vessels to use bottom trawl, longline, and multifilament gillnets targeting black hake (under "Demersal fishing" licence) in an area located south of 29º N and outside 12 nautical miles. However, only one licence has been used for the bottom trawl in the last three years. Since June 2010, no Spanish vessels are fishing for black hakes in Moroccan waters, because the conditions imposed by the new agreement are too restrictive for a fleet harvesting a low-valued resource.

The last ship targeting black hakes in this area had 308 GRT, 800 hp, and 33 m length overall. The CPUE for these species was 3600 kg of black hakes/fishing day from 2008 to 2010. The harvesting strategy of this type of vessels is aimed at landing high catch volumes of black hakes per fishing trip (averaging 29 t for the same period), which account for 90%-95% of the total catch. Due to the low market value of black hakes, this strategy helps to make the most of each fishing trip (Jiménez, 2006). The vessel was making fishing trips of 8 days (average) and ceased its activity in Moroccan waters during the closed season imposed to cephalopod trawling fleet. Then, from May to June and from October to December, the vessel was operating in Mauritanian fishing grounds where, due to the migratory pattern of black hakes, yields are higher at the end of the year. This vessel always fished between 400 and 900 m, no matter the fishing ground, both to catch the biggest and most valuable specimens and to minimise the discards of smaller fish. Traditionally, Cadiz has been the landing port, but in recent years the iced catch was freighted by road haulage from Dakhla, after paying the imposed Moroccan preceptive taxes.

2.2 Mauritania

Black hakes are targeted by a specifically directed fishery existing since the 1950s in Mauritanian waters and composed of Spanish trawlers and of some longliners which joined the fishery in the 1990s. This fleet has been the most important and constant in harvesting hake resources in waters off North West Africa. Other EU vessels (from Greece, Portugal, and Italy) have come to Mauritanian waters to harvest black hakes, but they were not numerous and they operated intermittently for short periods of time. Black hakes have been also exploited in recent years (from 1998 to 2006) by a domestic fleet of a few (3-4) wet-fish Spanish trawlers reflagged to Mauritania, but maintaining the same fishing strategy.

Special attention must be paid to the high volume of hake by-catch achieved by number of vessels, such as Mauritanian and EU (mainly Spanish) cephalopod freezer trawlers, whose hake catch yields exceed the yields achieved by vessels targeting hakes. The catch of hakes mainly corresponds to the closed fishing season imposed for vessels licenced for cephalopods, but hakes are also targeted in other moments, particularly when the cephalopod yields decrease.

European Union black hake fleets

The black hake trawler fleet has especially been operating in Mauritanian waters, first through private agreements and since 1987 into the framework of fishing agreements between the EU (formerly European Economic Community [EC]) and Mauritania (1987, 1990, 1993, 1996, 2001, 2003, 2006). The current agreement was signed in 2008 (COUNCIL REGULATION (EC) No. 704/2008[2]).

The fleet access to Mauritanian fishing grounds is run by a system of licences. This fleet operates under Fishing Category 2: "Black hake trawlers and bottom longliners", and does not include freezer trawlers. From 1992 to 1996, this fishing licence authorized to freeze the catch and a yearly average of 1100 t of black hake was landed freezed, compared to the more than 3000 t of black hake caught by traditional wet-fish vessels and stowed in ice. The freeze system was quickly abandoned, since this fishery had always been selling its catch in the fresh fish market.

Traditionally, part of this fleet has shared EU-licences with neighbouring countries, as Morocco-Western Sahara and Senegal. The Fishing Category 4: "Freezer trawlers fishing for demersal species" allowed the by-catch of black hake, but this licence has not been used since 2006. From 1993 to 2005, this fleet fished a yearly average of 1500 t of freezed black hake, even if the veracity of this figures has been always questioned by the fishing industry. In fact, it was very difficult to control and monitor the freezed landings of black hakes, which have never been verified.

The fleet was initially composed of big and powerful vessels, but from 2000 onwards they were gradually replaced by smaller and more modern units. In the last 20 years, this fleet has drastically reduced the number of their units, from 37 vessels in 1990 to only 2 operating nowadays (264 GRT, 480 hp, and 31 m lenght overall) and based at the port of Las Palmas (Canary Islands, Spain). Traditionally, this fishery has targeted large specimens of black hakes (*M. polli* and *M. senegalensis*), both species accounting for an average 92% of the catch from 2008 to 2010. In the same period, black hake total catch averaged 4960 t and yielded a mean of 3890 kg/fishing day. Main by-catch species are *Lophius vaillanti* (shortspine African angler), *Zeus faber* (John Dory),

[2] Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania for the period 1 August 2008 to 31 July 2012. (OJ L 203, 31.07.2008, p. 4–59)

Helicolenus dactylopterus (blackbelly rosefish), Elasmobranchii (sharks and skates), and *Schedophilus* spp., but in small proportions (Fernández *et al.*, 2004; FAO, 2010).

The agreement delimits a fishing zone for these fleets, and even if the regulation does not envisage a closed fishing season for the biological recovery of hake stocks, during the closed seasons enforced for cephalopod fishery, the limits of the fishing zone switches slightly to the North of Cape Timiris. Trawlers fish at depths ranging from 100 to 1000 m depending of the zone, although 80% of the fishing trips are carried out between 400 and 800 m.

These trawlers used to operate in Mauritanian waters throughout all the year and the fishing trips averaged 8 days. Catch is preserved in ice and is sorted and landed into four commercial categories, eviscerating the bigger specimens. About 3 years ago, the catch began to be freighted by road haulage from Nouadhibou (Mauritania) to the port of Cadiz (Spain), the traditional landing port for black hake. Due to their morphological resemblance and overlapping occurrence at certain depths, both black hake species are mixed in catches and are commonly marketed as *Merluccius* spp. Evaluation is therefore carried out as a single stock.

In recent years, the black hake longline fishery has reduced its units drastically and changed finally in 2009 the type of fishing licence from Category 2 to 3: "Vessels fishing for demersal species other than black hake with gear other than trawls". This fleet is now exclusively targeting the Atlantic pomfret (*Brama brama*) and achieves very low by-catches of black hakes. Under Category 3, this fleet had less constraints for fishing than trawls under Category 2, and their strategy was totally different. Progressively, the proportion of hake in total catch was reduced, both because the new licence agreement authorized the catch of 50% of other finfish species (only 25% authorized for trawlers and bottom longliners under Category 2) and due to the highest market value of the accompanying species. In fact, Category 2 vessels (trawlers and bottom longliners targeting black hake) used to target exclusively the Atlantic pomfret in the last days of the fishing trips. As this strategy showed to be more profitable, the percentage of the Atlantic pomfret increased in the total catch until the moment they finally switched to the new fishing Category 3. When operating as black hake trawlers and bottom longliners (category 2), the landed volumes per fishing trip were lower than those of the freezer trawlers, both due to the more reduced vessel capacity and to the catch limit of 15 t by trip (set by the corresponding fishing sector association in the 1990s). Black hake yields were also lower for these vessels licenced for category 2, averaging 1300 kg/fishing day (in 2008) for a total landing of only 183 t. The maximum level of catch was 952 t, reached in 1999. They are small-sized vessels operating in shallower waters than trawlers (until 500 m) and over inaccessible bottoms to the trawl. Their average technical characteristics are 153 GRT, 321 hp, and 26 m length overall.

Spanish black hake fleet has almost totally disappeared, as only 2 trawlers are still operating in Mauritanian fishing grounds, and mainly due to the end, in 2006, of the fishing agreement with Senegal; to the fishing conditions becoming more and more restrictive in Mauritanian waters (Iborra, 2010); and to the low market value of the resource (Jiménez, 2006).

This Spanish fleet has been the only one directed and permanently specialised to catch black hakes in Central Eastern Atlantic, particularly in Mauritanian waters.

2.3 Guinea-Bissau

No fishery directed to the fishing of black hakes has ever operated in Guinea-Bissauan EEZ in the framework of bilateral fishing agreements with the EU. *Merluccius polli*, the hake species most abundant in waters off Guinea-Bissau has never been a targeted species due to its low market value (small-sized, poor quality) and to its deep habitat. In addition, benguela hake yields are not high enough to make a fishery directed to this species economically sustainable. The Guinea-Bissauan

waters are the southern geographic limit of *M. senegalensis*, and its occurrence in this area is irrelevant.

Nevertheless, this species is present as by-catch in the landings of European fleets, such as cephalopod trawlers. Shrimper vessels also declare negligible hake catch, averaging 7 t from 2007 to 2009, which represents 1.6% of the total shrimper fleet catch.

Last year (2010), the most important non-European fleet operating in Guinea-Bissauan EEZ was the Chinese one, but their statistics do not record the catch of any hake species. Other countries, such as Mauritania, Morocco, Senegal, and Russia have also operated in these waters and, even if they are probably capturing hake as by-catch, their records are poor and irregular: no hake catch in 2007, and only 47 and 10 t in 2008 and 2009, respectively. More detailed information about these and another fleets by-catching hake in waters off Guinea-Bissau is given below and in section 3.2

Hake has accounted, as an average percentage, for 22% of the Spanish cephalopod trawlers' total catch (from 2006 to 2008), a high value for a by-catch considering that the average hake catch per year over the same period was 1000 t. Apparently, from 2006 to 2007, 65% of the Spanish cephalopod trawlers punctually targeted hake in some moments of the year, achieving fishing yields between 600 and 800 kg/fishing day. However, catch hakes have been drastically reduced in 2009 and 2010, accounting for 1% and 2% of the total catch, respectively.

M. polli catch data are only available for the last decade of cephalopod trawlers activity. Georeferenced data are available from 2007 to 2009 for most of the fleets. In addition, scientific data about *M. polli* have been gathered throughout the IEO demersal fishing surveys jointly carried out with Guinea-Bissauan authorities.

3. Other demersal finfish and elasmobranchs fisheries in North West African waters

Harvesting of demersal fish resources (other than hakes) in the North West African coastline is very ancient (Thiam et Thiam, 1984). Initially targeted by artisanal fleets, they are currently by-catched by specialised fleets, both artisanal and industrial, targeting other resources, and mainly cefalopods.

Demersal finfish resources are composed of around 100 different species, whose abundance is latitude dependent. From north to south, the majority temperate-affinity species of Moroccan waters are progressively replaced with tropical-affinity species, already found in West Saharan waters and dominant in Guinea-Bissauan waters

The main groups found in the northern catches belong to family Sparidae (sea breams), but only a few species of this group are been assessed in recent years. Families as Trichiuridae and Haemulidae are also significant in Spanish landings, whereas Sciaenidae are almost negligible. With the exception of sea breams, none of the families are considered in the recent fishery statistics provided to the FAO/CECAF Working Groups and only partial information of certain fishery data is available. The total catch of Rajidae (skates) and Selachii (sharks) is unknown, and when it is recorded, catch values are not separated by species, since there is no fishery directed to them. Only the trawl fleet targeting black hakes records the fishing of these elasmobranchs as by-catch with low values. In the southern part of the North West African coast, the main groups harvested in Guinea-Bissauan fishing grounds are Pleuronectiformes (Cynoglossidae [tongue soles] and Soleidae [soles]) and Carangidae (jacks and pompanos), while here the catch of Sparidae (sea breams) is very low.

During the 1960s there was a decline in sea breams' catch (formerly the main resource) in the northern fishing grounds of North West Africa, associated with an increase in cephalopods, and particularly in *Octopus* catch. The possibility of a replacement of Sparidae by cephalopods was then suggested by a number of authors (Bas *et al.*, 1970; Balguerías, 1985; FAO, 1986)

European fleets have been harvesting more intensely the northern sea bream resources, both by artisanal and industrial fleets. Historically, the fishing was more intense in the north due to the proximity of the fishing grounds, but with the southern expansion of industrial EU fleets 50 years ago began the exploitation of the finfish demersal resources off Mauritania, Senegal, and finally Guinea-Bissau. The evolution of these fleets has been different in each area, but the common features are the continual development of domestic fleets (artisanal and industrial) and the increasing presence of non-EU foreign fleets by-catching demersal finfish species. These fisheries are developed by a heterogeneous fleet of vessels (ranging from small canoes to bottom trawlers) using a number of different fishing gears. It is a very complex multispecies fishery, a fact that greatly hampers its management. Generally, more than one finfish species is targeted and most of the species in this group are fished as by-catch of many other specialised fisheries. As the catch level of most of these species in unknown, and the estimation of the fishing effort is very complex, there are nearly no assessment of the demersal finfish stocks in the area, thus explaining the inadequate management over those years of exploitation.

The detailed information from these fisheries is available in Anonymous, 1991; Poinsard, 1992; FAO, 1986; 2006a-b; 2007, in press; 2010, in press.

3.1 Morocco

Demersal fish resources in Morocco are exploited by a heterogeneous fleet composed of: Moroccan cephalopod freezer trawlers, coastal trawlers and longliners ("coastal" group heading), artisanal boats ("artisanal" group heading), joint ventures, and Russian vessels (operating under the bilateral Morocco-Russia fishing agreement).

In Morocco, the demersal finfish fishery is exploited either by fleets specifically targeting finfish or by other fleets that capture as by-catch. Demersal finfish are only targeted by Moroccan and Spanish artisanal units (longliners and some artisanal boats), whereas the remaining vessels capture them as by-catch.

The Spanish fleets targeting finfish are composed of bottom longliners in the northern area and artisanal units from the Canary Islands in the southern area, fishing with line, pole, and traps. The Moroccan fleet segments targeting finfish are also composed of longliners and of an unknown number of artisanal units (pirogues/canoes) harvesting finfish in shallow waters. The non-directed fisheries belong to two fleet segments: artisanal and industrial, both Moroccan and non-European. The Moroccan fleets are composed of coastal trawlers (artisanal) and cephalopod freezer trawlers (industrial). The main foreign fleet (non-European), whose activities remain unknown, is composed of the industrial Russian vessels, mainly.

The Canary Islands' artisanal fleet started the harvesting of the Western Sahara demersal finfish resources are in the 19th century, targeting the catch of seabreams, white grouper (*Epinephelus aeneus*), and croaker (*Argyrosomus regius*) (Balguerías, 1985). In the Moroccan northern coast, the Spanish artisanal units begin the exploitation of the finfish resources a very long time ago. These boats landed in ports located in the South of Spain. As time went by, these resources began to be harvested by domestic artisanal fleets and as by-catch of other Moroccan, European and foreign fleets.

Finfish resources have been exploited along time as by-catch by fleets of many different nationalities, such as Portugal, Japan, Korea, Poland, Italy, Ghana, Russia, Bulgaria, Romania, and former RDA. Available data by species are very scarce, and the Working Groups have always identified the fishery statistical deficiencies as the main problem to enable the assessment of the Moroccan finfish resources (Belveze y Bravo de Laguna, 1980; FAO, 1986).

From 2000 to 2006, no EU fleet was authorized to fish in waters falling within Moroccan jurisdiction due to the absence of a fishing agreement. Until 1999, these demersal finfish resources were exploited by the abovementioned artisanal Spanish fleet, and also in small proportion as by-catch of other EU fleets (cephalopod and shrimp freezer trawlers, mainly Spanish), as well as by other artisanal fleets targeting the catch of hake species.

European Union demersal finfish fleets

The new fishing agreement, signed in 2006, only two licences envisage the technical requirements to harvest demersal finfish as target species by EU fleets (Spanish and Portuguese): fishing categories 2 and 3.

The Fishing Datasheet No. 2 "Small-scale fishing/north" of the agreement, allows the fishing north of 30º 18' N, according 20 and 7 licences to Spanish and Portuguese bottom longliners of <40 GRT, respectively. At the moment, only around 10 Spanish boats are using this licence (average technical characteristics: 11.5 GRT, 105 hp, and 12.3 m length overall). The total catch averaged approximately 300 t (2008-2009), with the target species being scabbardfish (Trichiuridae) (84% of total catch), Sparidae (*Pagellus bogaraveo*, 9% of total catch), and other demersal species. In 2007, the estimated CPUE was of 294 kg/fishing trip of Trichiuridae and 47 kg/fishing trip of *P. bogaraveo*.

As the fishing grounds are near to Spanish waters, the fishing trips are of one day, and quite often the boats operate both in Moroccan and Spanish waters during the same day, which hinders the accurate monitoring of catch levels. All the licences are under use, even if only half of the fishing units have reported data. This fact does not necessary mean that the actual catch of this fleet is not reported or underestimated, since the non use of the fishing licences is mainly explained by the particular weather circumstances or fishing vicissitudes. The fishing datasheet No. 3 "Small-scale fishing/south" of the agreement, allows the fishing south of 30º 40' N, according 20 licences to Spanish vessels of <80 GRT (the so-called "Canary Islands artisanal boats"), with authorized gear of line, pole and traps. The target species are the croaker (*Argyrosomus regius*) and sea breams (Sparidae), according to the fishing Agreement. The fishing trips of these vessels vary from 1 to 5 days, and in some seasons (spring-summer) they change of fishing modality to fish for squid and tuna in other territorial waters. This type of licence has been poorly used throughout the validity of the fishing agreement, since only 6 vessels were fishing under it in 2010 (average technical characteristics: 43.2 GRT, 181 hp, and 18.5 m length overall).

The most fished species from 2007 to 2010 were: rubberlip grunt *Plectorhinchus mediterraneus* (24% of the total catch), followed by Sparidae, of which outstand the black seabream, *Spondyliosoma cantharus* (18% of the total catch) and *Dentex* spp. (*D. maroccanus* and *D. canariensis*) (32% of the total catch). The genus *Pagellus*, whose species are, in decreasing order. *P. bellottii*, *P. erythrinus*, and *P. acarne*, accounted only for 6% of the total catch. The share per families is leaded by the Sparidae (accounting for 66% of the total catch), followed by the catch of rubberlip grunt (24%), Sciaenidae (3,25%), Congridae (2,75%), and other families such as Serranidae and Muraenidae (Presas, 2011 a). Different averaged yields (2009-2010) by species are: 111 kg/fishing day for *P. mediterraneus*, 140 kg/fishing day for *Dentex* spp., and 31 kg/fishing day for *Pagellus* spp. The Canary Islands artisanal fleet operates mainly at 100 m depth in the area between Cape Bojador and Cape Blanc, mostly concentrating in the area between 22º N and 24º 30' N.

Moroccan demersal finfish fleets

The development of the Moroccan finfish fishery occurred in the second half of the 20th century, when different fleets (trawl, longline, gillnet, canoes) started both targeting finfish or as associated caught species.

Demersal finfish resources are now targeted by a heterogeneous domestic fleet composed of some artisanal boats using many different gears (hand line, gillnet, tremail, longline, traps) and of the coastal longliners. Other Moroccan fleets also harvest finfish resources as by-catch in large quantities, mainly the cephalopod freezer trawlers, whose catch account in the statistics for most of the capture, and the coastal trawlers. In fact, the catch of demersal finfish species made by the cephalopod freezer trawlers is the most relevant in the Moroccan statistical data about this group of species.

In 2008, the Moroccan artisanal fleet was composed of about 4000 boats, smaller than 2 tons GRT and equipped with outboard motors (15-25 hp). The number of boats targeting demersal finfish species and the catches are very diversified and difficult to quantify. The fishery takes place usually along the coastline, but they can go beyond the 20 nautical miles zone. The technical characteristics of the longliners are unknown. The Moroccan statistics only record as a single data the catch of the coastal longliners targeting these species, and the catch of the coastal trawlers that capture them as by-catch.

In 2008, the fleet of cephalopod freezer trawlers consisted of 277 units with an average power (GRT) of 600-2000 hp, 200-600 GRT, and 30-40 m length overall. The most relevant catch of demersal finfish species of this fleet is of the following species: *P. acarne*, *Sparus* spp. (*S. auriga* and *S. aurata*), *Pagellus* spp. (*P. bellottii* and *P. erythrinus*) and *Dentex macrophthalmus*. This fleet had a closed fishing season for the biological recovery of two months (May and June), but from 2008 onwards it has been extended also to September and October. The first closure is to protect the spawners and the second is to protect the recruitment. The coastal trawl fleet has been already described in the hake section, but its catch of associated species is unknown.

The catch of sea breams was mostly achieved south of Agadir, between 30 and 90 m depth, and the maximum catch levels were recorded in 1974 in Moroccan waters, reaching 79 000 t, under an excessive exploitation level (Belveze y Bravo de Laguna, 1980). The resource has been declining, and in 2008 the Moroccan fleet recorded a catch of about 7600 t of the Sparidae groups already cited.

Russian vessels operating under the Morocco-Russia fishing agreement are also harvesting these demersal resources, as do fleets from other EU countries since 2007. In addition, it is possible that other fleets under bilateral agreements or joint ventures are also by-catching species of demersal finfish stocks.

3.2 Guinea-Bissau

In the southern area of North West Africa, the fishing was considered a subsistence activity in Guinea-Bissau before 1974, year of its independence. After the onset of an industrial fishery in 1978 meant the entry, under a licensing system of foreign (European and former URSS) trawlers and longliners to Guinea-Bissauan waters. This fleet was progressively replaced by fleets from the European Union and Asian countries.

Two fleet segments exploit demersal finfish stocks in Guinea-Bissauan waters, one composed of artisanal vessels and another composed of industrial units.

The artisanal fleet is composed of a large number of ships from Guinea-Bissau and Senegal, powered by engines <40 hp. Their catch is composed of a variety of species of finfish and shallow water prawns, whose volume is entirely unknown.

The industrial fleet harvest demersal finfish outside of territorial waters (beyond the 12 nautical miles area). It is a fleet mainly composed of European and Chinese trawlers, although some vessels are from other nationalities. Actually, these industrial fleets are targeting other resources, but demeral fish are significantly by-catched (sometimes showing very high values, mainly from 2007 to 2009).

No catch of Sparidae has ever been recorded for the whole fleets operating in Guinea-Bissau, which means that this is not an important resource. Sparidae accounted for 12% of the total bony fish' biomass recorded in a scientific trawling survey carried out in 2008, but the fished specimens of the most representative genus of this family (*Dentex*) were undersized. Then, it is probable that the fleets are catching that small-sized sea breams, but discard them. The most fished sea bream species in demersal trawling scientific surveys carried out in Guinea-Bissauan waters were: *Dentex* spp. (mainly *D. maroccanus*, *D. congoensis*, and *D. angolensis*) and *Pagellus bellottii and Pagrus africanus*. Among the most fished groups by all the fleets operating in the area, flatfishes (Pleuronectiformes), are represented by an important mix of species belonging to two main families: Cynoglossidae (*Cynoglossus browni* and *C. canariensis*) and Soleidae (*Solea senegalensis, Pegusa/Solea lascaris*, *Dicologoglossa cuneata*, *D. hexophthalma, Microchirus frechkopi* and *M. variegatus*). It is worth noting that no specimens of *Solea* spp. were fished during scientific surveys.

A detail description of the industrial trawl fleets operating in the Guinea-Bissaun waters is presented in the section of this report referred to the cephalopod and shrimp fisheries.

European fleets

Currently, Spain and Portugal are the only EU countries that operate in waters off Guinea-Bissau, and traditionally the Spanish fleet has been the most important. These vessels are mainly cephalopod and shrimp freezer trawlers, operating under the Fishing Categories 1 and 2 of the agreement, respectively.[3]

Both fishing categories impose the same constraints and conditions for all fleets, European and foreign. Under fishing licence 1, named "Freezer, finfish and cephalopod trawlers", two types of fishing strategies are allowed: targeting finfish (almost considered as another licence, and rarely chosen by EU fleets), but limited to a maximum percentage of 9% of crustaceans and up to 9% of cephalopods, or targeting cephalopods, and then the finfish catch cannot exceed 9% of the total catch.

A detailed description of these freezer trawl fleets in Guinea-Bissauan waters is presented in the section of this report referred to the cephalopod and shrimp fisheries.

Cephalopod trawlers are the main EU fleet exploiting demersal finfish resources. They have a by-catch limitation of up to 9% of total catch of crustaceans, which allow the fishing of high finfish volumes. The vessels operating under licence 1 are targeting cephalopods but they also harvest a significant proportion of demersal fish species when having no by-catch limitation. As an example, in 2010 the cephalopod trawlers reported the catch of only 27% of the targeted cephalopod species, while they reported the catch of 22% flatfishes (Pleuronectiformes) and 50 % of other finfish

[3] FISHERIES PARTNERSHIP AGREEMENT between the European Community and the Republic of Guinea-Bissau for the period 16 June 2007 to 15 June 2011. (OJ L 342 27.12.2007, p. 5–37).

species, such as horse mackerel (*Trachurus* spp.), bearded brotula (*Brotula barbata*), and the already mentioned (section 2.3) benguela hake (*M. polli*). The cephalopod trawlers target demersal finfish species when the cephalopod yields are poor. In that case, this fleet operates more like a multi-species one, and their strategy in some fishing trips is closer to that of finfish freezer trawlers than to cephalopod trawlers, in spite of being licenced as the second. Flatfishes (Pleuronectiformes) are always represented in this cephalopod trawlers fleet catch, accounting as an average (2006-2010) for 16% of their total catch (538 t).

The rare vessels operating under licence 1 but targeting finfish are trawlers fishing a high number of finfish, mainly flatfishes and horse mackerel (*Trachurus* spp.)

European shrimp trawlers harvest also finfish, although in lower proportion than cephalopod trawlers. For shrimpers, the targeted crustacean species account for an average (2007-2009) percentage of total catch of 69 %, flatfishes (Pleuronectiformes) up to 9%, cephalopods 7%, and different finfish species, such as horse mackerel (*Trachurus* spp.), West African goatfish (*Pseudopenaeus prayensis*), and punctually some sea breams. The catch composition of the shrimp trawlers is more similar to that of a shrimper fleet. The fishing agreement bans the catch of more than 50% of the total catch of cephalopods and finfish.

Other foreign fleets

Chinese (PRC) fleet uses the same fishing gears than EU vessels, but its fishing strategy and the specific composition of the catches is totally different. The only common feature is that both fleets always catch flatfishes. The Chinese fleet does not show a dominance of the target species in its catch, regardless of the Fishing Category for what it is licensed, behaving more like a multi-species fishery. Therefore, in 2007 the percentage of crustaceans in the total catch of shrimper trawlers was of 1.75%, whereas the percentage of cephalopods in the total catch of cephalopod trawlers was of 11.8%. In 2008, the percentage of cephalopods in the total catch of cephalopod trawlers was only 7.4%, and the percentage of crustaceans in the total catch of shrimper trawlers was under 1%. Surprisingly, the corresponding proportions of finfish are very high, with outstanding catch volumes of croaker (*Argyrosomus regius)*, sea-catfish (*Arius* spp.) and lesser African threadfin (*Galeoides decadactylus)*. These last two species are of tropical-affinity and very representative of Guinea-Bissauan waters. Their proportions in the catches of the three licences used in 2007 and 2008 were very similar. This fleet seems to target similar species and in similar proportions, regardless of the Fishing Category used (shrimps, cephalopods, and finfish). The Chinese fleet does not report black hake catch, and the reported catch of sea breams (Sparidae) are negligible and punctual.

BACKGROUND

The Fisheries Partnership Agreements (FPAs) allow the European fleet to have access to surplus resources which the third country is not able to exploit. There are presently three mixed agreements with West African countries which provide access to demersal stocks: Morocco, Mauritania and Guinea-Bissau.

The scientific advice on the stock status and on exploitation levels is provided by the Joint Scientific Committees (JSC) established by the mixed agreements, which include scientists from the EU and the third country. For the agreements with West African countries, the JSC base their advice on available data and information, and also on reports by the FAO Fishery Committee for the Eastern Central Atlantic (CECAF), in particular its Scientific Sub-Committee and the Working Groups.

For the FPAs with Morocco, Mauritania and Guinea-Bissau the STECF is requested to provide the following advice on the demersal stocks exploited by European vessels:

1. Demersal fish stocks status and classification of stocks according to biological reference points,
2. Whether the EU fleets targeting demersal fish species are presently fishing the surplus of the exploited resources[4],
3. Level of catches or fishing effort for the EU fleets targeting demersal fish species, corresponding to fishing the surplus of the resources - if possible, with short and medium term projections,
4. Closed seasons or closed areas which could be defined for demersal fish fisheries,
5. Whether management of the demersal fish stocks concerned is in accordance with the Marine Strategy Framework Directive (environmental pillar of the Integrated Maritime Policy) to reach Good Environmental Status by 2020[5],
6. Assessment of present management measures against the MSY strategy[6] (catch limit, effort limit, closed seasons or areas),
7. Assess the relative impact of the EU fleets fishing demersal fish specie considering the overall demersal fishing activity in the area of the FPA,
8. Whether the analysis and methods applied to provide scientific advice are adequate to the available data/information (biological and fishery).

STECF should base its advice on the reports of the JSC, on information available from CECAF and on any other available information. In general, the biological and fishery information available to perform analysis and on which to base the scientific advice is limited both in terms of quality and

[4] Surplus, as defined by UNCLOS - UN, United Nations Convention of the Law of the Sea of December 1982, Part V: Exclusive Economic Zone.

[5] DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June2008 establishing a framework for community action in the field of marine environmental policy (MarineStrategy Framework Directive), and COMMISSION DECISION (2010/477/EU) of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (Descriptor 3, part B, of the Annex).

[6] COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT - Implementing sustainability in EU fisheries through maximum sustainable yield - COM(2006) 360 final

quantity. As an example, fishery-independent information is scarce. Also, it is crucial that not only fishery information from the EU is available, but also from other fleets active in the same area.

Advice to be provided for the stocks listed below. Advice should be provided by management area. The management areas of the species listed below might overlap different EEZ.

Morocco

Demersal species:

- *Merluccius merluccius*
- *Merluccius* spp. (*M. senegalensis* and *M. polli*)
- *Raja* spp.
- Croaker (Sciaenidae)
- Sea bream (Sparidae)
- Scabbardfish (Trichiuridae)

Sharks:

- *Centroscymnus coelolepis*
- *Centrophorus* spp.
- Other shark species

Mauritania

Other demersal species:

- *Merluccius* spp. (*M. senegalensis* and *M. polli*)

Guinea-Bissau

Other demersal species:

- *Solea* spp.
- *Merluccius* spp.
- *Pagellus* spp.
- Other demersal species.

SCIENTIFIC ADVICE

1. DEMERSAL FISH (HAKE, OTHER FINFISH AND ELASMOBRANCHS) STOCKS STATUS AND CLASSIFICATION OF STOCKS ACCORDING TO BIOLOGICAL REFERENCE POINTS

Below are presented the results of the last assessments carried out on hake and other demersal finfish species. These assessments have been carried out in the scope of FAO/CECAF (Fishery Committee for the Eastern Central Atlantic) Working Groups on the Assessment of Demersal Resources.

For each species, the separation of the stocks considered in this document is the one adopted by the corresponding FAO/CECAF Working Groups on assessment, which arbitrarily defined the structure of the stocks in the area taking into account both the availability of fishery statistical data, and geopolitical reasons (stocks are mostly within the geographic boundaries of each of the considered countries). This is a consequence of the absence of scientific evidences enabling the identification of hake and other demersal finfish stocks in West African waters. In fact, the structure of these stocks is a controversial issue, since Poinsard (1992) pointed out in its North Western African hake stocks studies that black hakes were not a single stock distributed from 24º N to 15º N. This is why, for some species, different stock definitions have been attempted, even if the assessment was finally done considering the stocks within the geographic boundaries of each country.

1.1. MOROCCAN STOCKS

1.1.1. Hakes

Merluccius merluccius. **Moroccan stock**

The European hake (*M. merluccius*) stock status in Morocco was assessed during the last FAO/CECAF Working Group on the Assessment of Demersal Resources (Subgroup North), carried out in Agadir (Morocco) in February 2010 (FAO, 2010). The Schaefer dynamic production model and its fitting were implemented in a MS Excel spreadsheet under the BIODYN package (Punt and Hilborn, 1996; Barros, 2007). A Length Cohort Analysis (LCA) and a Yield per Recruit model were also performed for this assessment.

Three tests were carried out to assess the global model:

- As input data for the first test were entered total catch data of European hake from all the fleets and the CPUE time series of the Moroccan coastal fishery, both from 1995 to 2008.
- For the second test we entered the time series of abundance indices obtained in Moroccan scientific surveys from 1995 to 2007 (the abundance index for year 2008 was estimated from the model).
- The third test was performed entering the total catch data of European hake from all the fleets, and the CPUE series of the Moroccan coastal fishery, both from 1995 to 2007.

The total catch is that of the Spanish fleets (trawl, gillnet and longline), the Portuguese polyvalent fleet (both from1995 to 1999), and the Moroccan coastal fleet (1995-2008). Data of longliners operating as joint ventures were not available, and thus they are not included in the model.

The 2010 Working Group decided this time to enter in the model the global abundance indices obtained from scientific surveys, and corresponding to the stratified average of the observed yields in the two zones surveyed and for all depth strata.

The model was fitted to data taking into account the presumable environmental effects on the abundance of the stock over the period 1997-2000, according to the studies on the influence of the North Atlantic Oscillation (NAO) on the abundance of hakes in the North West African coast (Meiners, 2007; Meiners *et al.*, 2006; 2007c).

For the Length Cohort Analysis (LCA), data considered were those of length frequencies from the coastal fishery targeting European hake (period 1988-2008), growth parameters, and the length–weight relationship.

The model achieved good fits for all the three data sets, but the model was best fitted to abundance indices of scientific surveys. In fact, this series is the most representative of the actual abundance of the stock, because the surveys covered the entire distribution range of European hake in the area. Furthermore, the CPUE time series of the Moroccan coastal fleet was not fully representative of the species abundance, since the European hake catch of the joint venture longliners is unknown. For all these reasons, the 2010 Working Group adopted the results of the evaluation considering the total catch time series (from 1995 to 2008) and the series of abundance indices of scientific surveys (from 1995 to 2007).

The results of the evaluation indicate that the European hake is heavily over-exploited. The current biomass (B_{cur}) was below the target biomass ($B_{0.1}$), and the current effort (F_{cur}) is greater than the target effort ($F_{0.1}$) and exceeds the effort that would provide a sustainable catch at current biomass level ($F_{SYcur)}$ (Table 1.I). This means that present catch levels exceed the natural production of stock. Figure 1.1 graphically depicts the dramatic situation of the fishery.

Table 1.I. Indicators of the stock status of *Merluccius merluccius* in Morocco, according to the estimated Reference Points (dynamic production model).

Stock/abundance index	$\mathbf{F_{cur}/F_{SYcur}}$	$\mathbf{B_{cur}/B_{0.1}}$	$\mathbf{F_{cur}/F_{0.1}}$	$\mathbf{B_{cur}/B_{MSY}}$	$\mathbf{F_{cur}/F_{MSY}}$
Merluccius merluccius/ Moroccan surveys (1995-2007)	243%	57%	371%	63%	334%

F_{cur}/F_{SYcur}: Relationship between the fishing mortality coefficient effectively observed the last year of the series and the fishing mortality coefficient that would provide a sustainable catch at the current biomass level.

$B_{cur}/B_{0.1}$: Relationship between the biomass estimated for the last year and the target biomass.

$F_{cur}/F_{0.1}$: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the target effort.

B_{cur}/B_{MSY}: Relationship between the biomass estimated for the last year and the biomass that would provide the Maximum Sustainable Yield (MSY).

F_{cur}/F_{MSY}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the fishing mortality coefficient that would provide the Maximum Sustainable Yield (MSY).

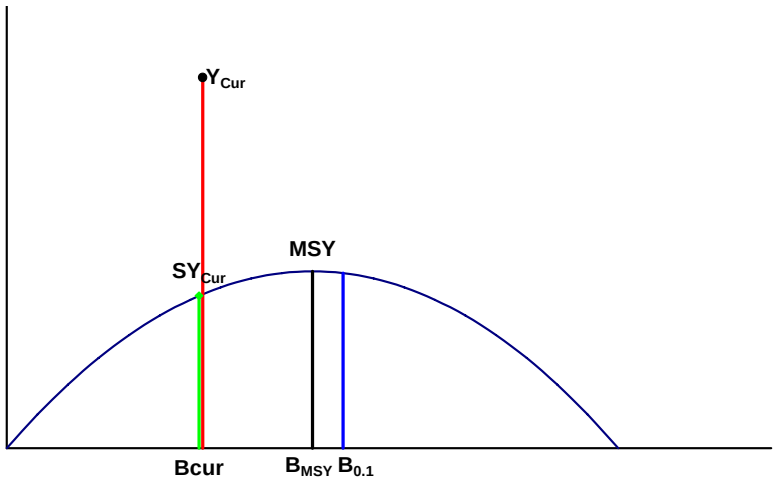

Figure 1.1. Graphical presentation of the status of the stock and the fishery of *Merluccius merluccius* in Moroccan waters in the last year considered (2008), in relation to the Reference Points estimated for the stock.

The analytical model LCA also resulted in a value of the current effort (F_{cur}) well above the target effort ($F_{0.1}$), which corresponds to the target biomass ($B_{0.1}$), and the maximum effort (F_{MAX}) that can be exerted in the fishery (Table 1.II). In recent years, the yield per recruit model showed an over-exploitation of the juveniles, with high fishing effort levels exerted over lower-sized classes (Fig. 1.2).

Table 1.II. Indicators of the stock status of *Merluccius merluccius* in Morocco, according to the estimated Reference Points (Length Cohort Analysis, LCA).

Stock	**$F_{cur}/F_{0.1}$**	**F_{cur}/F_{Max}**
Merluccius merluccius/Moroccan coastal fishery (1988-2008)	833%	294%

$F_{cur}/F_{0.1}$: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and $F_{0.1}$.
F_{cur}/F_{MAX}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and F_{MAX}.

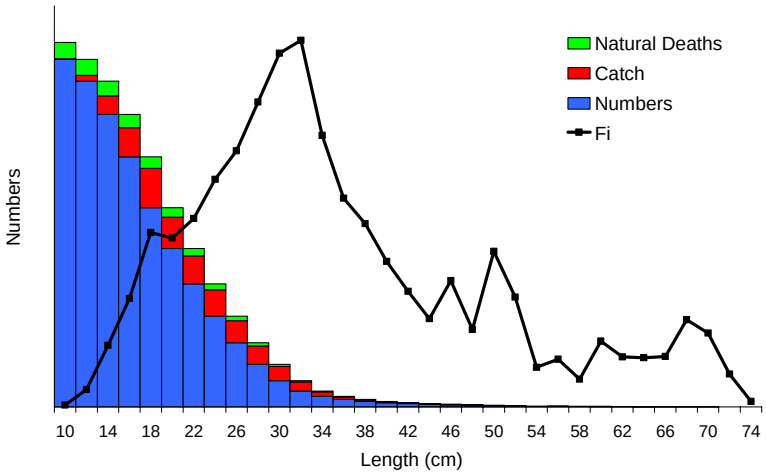

Figure 1.2. Fishing mortality vector (Fi) by length class obtained by Length Cohort Analysis (LCA) for *Merluccius merluccius* in Moroccan waters, over the period 1988-2008.

The estimated yield per recruit curve (Fig. 1.3) also showed the need of reducing in approximately 65% the fishing mortality (F) to achieve the maximum yield of the stock.

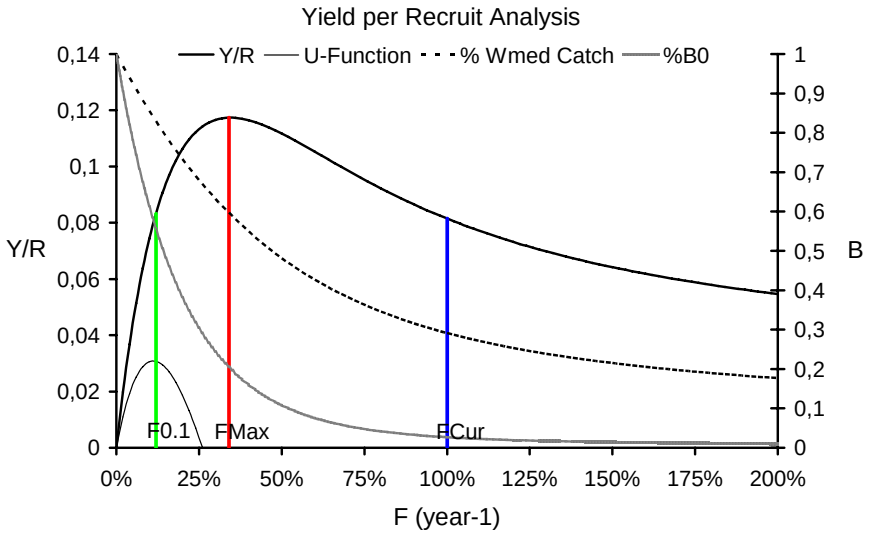

Figure 1.3. Yield per Recruit analyses for *M. merluccius* stock in Moroccan waters, over the period 1988-2008.

This diagnosis of over-exploitation is confirmed by the continuing slump, since 2003, of the abundance indices of the coastal fishery, and is also in agreement with all the previous assessments of past Working Groups (FAO, 1979; 1986a; 1990; 1991; 1997; 2006a y b; 2007; 2010). In fact, the resource was already over-exploited in 1978, being at that moment the reduction in fishing mortality required to maximize the yield per recruit of 76 % (FAO, 1979).

In the 2004 assessment (FAO, 2006 b), the LCA pointed out that the survival of the recruits was so low that the fishery was about to collapse at any moment. In 2010, the results of the assessments were similar, and confirmed by the decreasing trend observed in the abundance indices from Moroccan scientific surveys. However, the fishery is still going on.

Conclusion: The Moroccan stock of *M. merluccius* is heavily over-exploited, and fishing effort is mainly exerted over the juvenile size classes.

The results and our knowledge of the fishery undoubtedly demonstrate an over-exploitation of this stock, even if the fishery statistics are certainly defective, since they are neither considering the by-catch of other fleets nor the discards of all fleets. However, we ignore the stock ability to respond to such a fishing pressure, and to the climatic conditions experienced in the 2000s, recently evidenced as adverse for this species in Moroccan waters (Meiners *et al.*, 2010).

Over the years, European hake has already experienced higher levels of harvesting, without ever noticing any collapse of the fishery, a fact that must be assumed as an evidence of the resilience level of hake populations. Hake resistance is probably due both to the fact that its growth rate has been systematically underestimated to date, and to their voracity, feeding on a wide range of preys, making of hake a very competitive and efficient species (Riis-Vestergaard *et al.*, 2000). The most recent European hake growth studies, carried out in North East Atlantic ICES areas, have pointed out that, during their first year of life, European hake grows at a faster rate than commonly accepted (de Pontual *et al.*, 2006; Piñeiro *et al.*, 2008).

Thus, this scientific misgiving about growth rate is obviously impacting the age distributions of the catch and abundance indices used as inputs in the age-structured analytical models (de Pontual *et al.*, 2006) for assessment purposes by ICES Working Groups. The possibility that similar problems occur in the analytical models used in CECAF WGs should be considered.

Merluccius senegalensis and *Merluccius polli.* Stock Morocco

The last assessment of black hake species (*M. senegalensis* and *M. polli*) from Moroccan waters was made in the FAO/CECAF Working Group on the Assessment of Demersal Resources, carried out in Conakry (Guinea) in September 2003 (FAO, 2006 a). The chosen model for the assessment of this stock was the logistic surplus production model, implemented on a MS Excel spreadsheet and modified using the BIODYN software (FAO, 1998).

As input data were entered the catch series (from 1983 to 1999 [end of Morocco fishing agreement]) of black hake from Spanish fleets (trawl, gillnet, and longline) and the CPUE (kg/fishing day) for the Spanish trawlers used as abundance indices series. Due to their morphological resemblance and overlapping occurrence at certain depths, both species are mixed in catches and are commonly marketed as *Merluccius* spp Thus, the available catch data correspond to the fished amount of the two species. Assessment is therefore carried out considering *Merluccius* spp as a single stock, a common practice for other hake resources of the world (Bezzi *et al.* 1995; Payne and Punt, 1995).

The model was satisfactorily fitted to CPUE observed data (Pearson R=0.81), except at the beginning of the series. The results showed that this stock was clearly over-exploited. The black hake current biomass (biomass of the stock in the last year of data,B_{cur}) was around half of the biomass that would produce maximum sustainable yield (B_{MSY}), whereas the current fishing effort (fishing mortality by fishery in the last year, F_{cur}) was above that necessary to extract the whole natural production of the stock (F_{SYcurB}) The current biomass (B_{cur}) was below (57%) the target biomass

($B_{0.1}$) and the current effort (F_{cur}) was greater (81%) than the target effort ($F_{0.1}$) (Table 1.III). Figure 1.4 graphically shows the stock status.

Table 1.III. Indicators of the stock status of *Merluccius* spp in Morocco, according to the estimated Reference Points (dynamic production model).

Stock/abundance index	**F_{cur}/F_{SYcur}**	**$B_{cur}/B_{0.1}$**	**$F_{cur}/F_{0.1}$**	**B_{cur}/B_{MSY}**	**F_{cur}/F_{MSY}**
Merluccius spp/Spanish trawlers (1983-1999)	107%	43%	181%	47%	163%

F_{cur}/F_{SYcur}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the fishing mortality coefficient that would provide a sustainable catch at the current biomass level.

$B_{cur}/B_{0.1}$: Relationship between the biomass estimated for the last year and the target biomass.

$F_{cur}/F_{0.1}$: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the target effort.

B_{cur}/B_{MSY}: Relationship between the biomass estimated for the last year and the biomass that would provide the Maximum Sustainable Yield (MSY).

F_{cur}/F_{MSY}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the fishing mortality coefficient that would provide the Maximum Sustainable Yield (MSY).

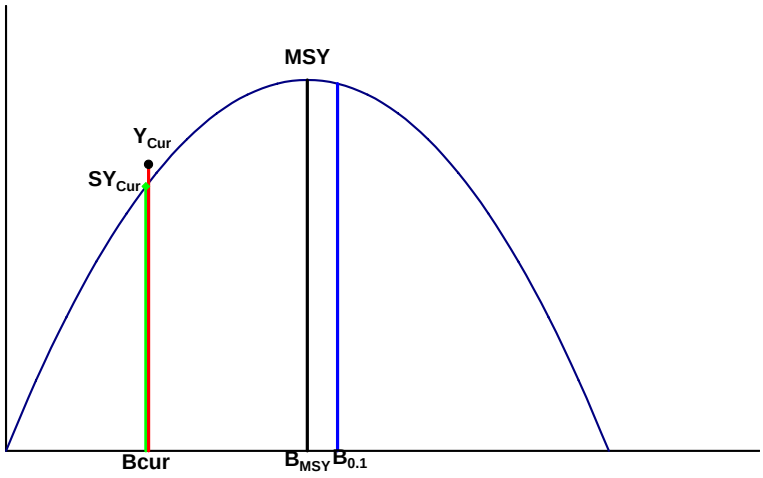

Figure 1.4. Graphical presentation of the status of the stock and the fishery of *Merluccius* spp in Moroccan waters in the last year considered (1999), in relation to the Reference Points estimated for the stock.

Conclusion: The last assessment (2003) of the Moroccan black hake stock revealed a status of over-exploitation. Since 2007, the high values of the abundance indices suggest a recovering of the stock.

The lasts Spanish vessels fishing for black hake in Moroccan waters recorded (in 1999) an average CPUE value of more than 3500 kg/fishing day, the highest value of the available time-series (Figure 1.5). These CPUE data were good estimators of the abundance of the species, as they came from much specialised vessels directly targeting black hake species. In spite of the lack of a more recent assessment taking into account all these data, and bearing in mind the low fishing effort currently exerted over black hake stock (there are no fleet targeting black hake, which are only fished as by-

catch by the Moroccan coastal fleet), we could think that the black hake stock is not currently over-exploited.

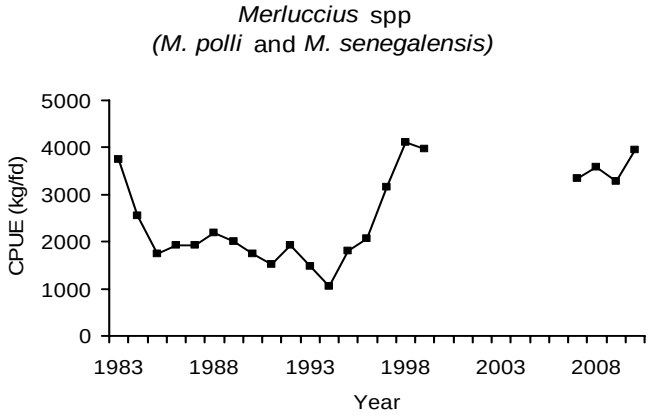

Figure 1.5. Catch per unit of effort, CPUE (kg/fishing day) of black hake (*Merluccius polli* and *M. senegalensis)* by the Spanish trawl fleet in Morocco (1983-1999 under fishing agreement; 2000-2006 without fishing agreement in force).

1.1.2. Demersal finfish

Other demersal finfish have been poorly assessed due to the difficulties in obtaining reliable fishery statistical data. A high number of species and many fleets are involved in this fishery, but species can be targeted or fished as by-catch, and their catch is not specifically recorded. In fact, the magnitude of the catch of most of these species in Moroccan waters is unknown, even if some data are available for the most recent years and have allowed attempting a few assessments.

Considering the relative importance of the main species, and the availability of data, the CECAF Working Groups were able to estimate annual series of production data from some species or groups of species in previous years (FAO 1986; 1997; 2006a-b; 2007; 2010). The last FAO/CECAF Working Group on the Assessment of Demersal Resources (Subgroup North), held in Agadir (Morocco) in February 2010 (FAO, 2010) assessed three Sparidae species exploited in Moroccan waters: *Pagellus acarne*, *Sparus* spp (*Sparus auriga* and *S. aurata*), and *Pagellus* spp (*P. bellottii* and *P. erythrinus*); and also the large-eye dentex **(***Dentex macrophthalmus*) in the whole area (Morocco, Mauritania, and Senegal). Other species exploited in waters off Mauritania and Senegal was also assessed.

All the assessments used the Schaefer dynamic production model and their fitting, as implemented in a MS Excel spreadsheet under the BIODYN package (Punt and Hilborn, 1996; Barros, 2007). The only assessment accepted was that of *P. acarne*; whereas for the other species the estimated abundances from the model did not produce a good fit to the actually observed data. Data deficiencies (underestimation of the total catch and/or inappropriate abundance indices) are likely to explain this lack of fit. In such cases, were analysed the trends of the time series of available abundance indices for each species. Surprisingly, some of these analyses showed a clear increasing trend.

As said before, the separation of the stocks considered is the one adopted by the corresponding FAO/CECAF Working Groups on assessment, which arbitrarily defined their structure on the basis of the exploiting fleets and the availability of fishery data per area/fishing ground, as no biological data exist on the identity of possible demersal finfish stocks in North West African waters.

In Moroccan fishing grounds, the unique fleets directed to demersal finfish resources are the Moroccan artisanal and longliner vessels, and the Spanish artisanal fleet. Russian vessels and longliners operating under joint venture agreements also harvest these resources, but as by-catch. For all the presented assessments, the input data were the catch series (1990-2008) from all Moroccan fleets fishing these species: coastal trawl and longline, cephalopod freezers and artisanal vessels (pirogues). Catch data of the Spanish artisanal fleet were also jointly considered, but their availability period only covered 2007 and 2008, as the catch data for this Spanish artisanal fleet over the period of operation under successive Morocco-EU fishing agreements (which ended in 1999), were not available. Nevertheless, compared to the Moroccan catch, the volume of the Spanish artisanal fleet was irrelevant. The data of Moroccan coastal fleet included the trawl and longline catch together. However, we must remind that some relevant data are lacking in the input data considered for the assessment: the data of demersal finfish by-catch of russian vessels and joint venture longliners.

Pagellus acarne. Moroccan stock

Axillary seabream, *P. acarne*, is regarded as forming a single stock in waters off Morocco.

Available data for this species were: catch of artisanal Moroccan and Spanish fleet, only from 2007 and 2008; continuous catch series for the Moroccan coastal vessels and cephalopod freezers, between 1990 and 2008. In the last years of the data series available for cephalopod freezers', the axillary seabream catch registered low values because the closed eason was extended to 2 more months of biological recovery (FAO, 2010).

The yield data (kg/h) recorded during the Moroccan trawl scientific surveys carried out between Cape Bojador and Lagouira (Southern Morocco) from 1990 to 2008 was used as input data series of global abundance indices.

Althougth the model did not fitted satisfactorily to the observed abundance indices, it was accepted by the WG, as it showed the same results that previous assessments. Therefore, *P. acarne* stocks appeared to be over-exploited, a status already observed in 2004 (FAO, 2006 b) and 2007 assessment Working Groups, but currently to a greater degree (FAO, 2007). In 2007 and 2004 Working Groups, the model provided also a better fit to the data series of the abundance indices recorded during the surveys than to the data series of cephalopod trawlers' CPUE. The current biomass (biomass of the stock in the last year of data, Bcur), was lower than the target biomass (B0.1), and the current fishing effort (fishing mortality by fishery in the last year, Fcur) was much higher than the target fishing effort ($F_{0.1}$). The results were very similar with respect to the biomass that would provide the Maximum Sustainable Yield (B_{MSY}) and the fishing effort associated with this biomass (F_{MSY}) (Table 1.IV). Figure 1.6 graphically represents the *P. acarne* stock status.

Table 1.IV. Indicators of the stock status of *Pagellus acarne* in Morocco, according to the estimated Reference Points (dynamic production model).

Stock/abundance index	**F_{cur}/F_{SYcur}**	**$B_{cur}/B_{0.1}$**	**$F_{cur}/F_{0.1}$**	**B_{cur}/B_{MSY}**	**F_{cur}/F_{MSY}**
Pagellus acarne/Moroccan surveys	138%	32%	252%	35%	227%

F_{cur}/F_{SYcur}: Relationship between the fishing mortality coefficient effectively observed the last year of the series and the fishing mortality coefficient that would provide a sustainable catch at the current biomass level.

$B_{cur}/B_{0.1}$: Relationship between the biomass estimated for the last year and the target biomass.

$F_{cur}/F_{0.1}$: Relationship between the fishing mortality coefficient effectively observed the last year of the series and the target effort.

B_{cur}/B_{MSY}: Relationship between the biomass estimated for the last year and the biomass that would provide the Maximum Sustainable Yield (MSY).

F_{cur}/F_{MSY}: Relationship between the fishing mortality coefficient effectively observed the last year of the series and the fishing mortality coefficient that would provide the Maximum Sustainable Yield (MSY).

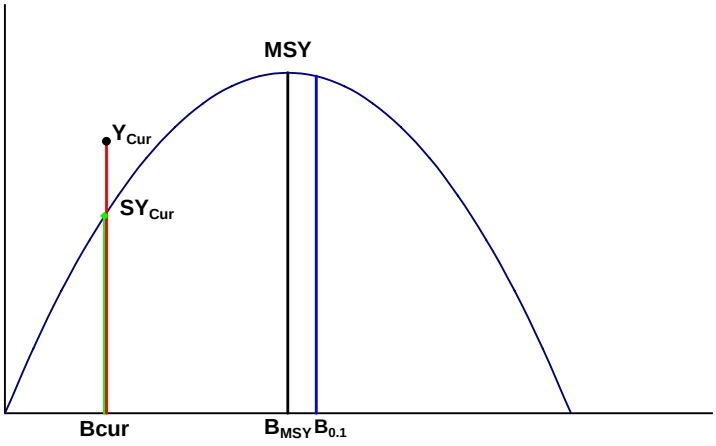

Figure 1.6. Graphical presentation of the status of the stock and the fishery of *Pagellus acarne* in Moroccan waters in the last year considered (2008), in relation to the Reference Points estimated for the stock.

Only Moroccan artisanal and longline vessels, as well as artisanal Spanish vessels are targeting this species. However, the level of their landings is much lower than the landings recorded for Moroccan cephalopod trawlers and Moroccan coastal fleet. Coastal Moroccan vessels have increased in recent years their catch of axillary seabream, which reached a maximum value of 3569 t in 2007. In addition, over the last 6 years of the time series, the axillary seabream catch of coastal vessels has been 5 times greater than the catch recorded for Moroccan cephalopod trawlers' fleet. It is worth noting that last year, the closed season was extended 2 months, a fact undoubtedly having an influence on its catch and, consequently, on its CPUE, since it is not a fleet directed to this resource. *P. acarne* CPUE values of the cephalopod trawlers' fleet showed a dangerous decreasing trend after the maximum of 77 kg/fishing day reached in 2001, with minima of 1.4 and 3.8 kg/fishing day in 2007 and 2008, respectively. However, these CPUE fluctuations are more due to the fishing strategy of the fleet than to the abundance of the resource. Therefore, reasonable doubts exist about the reliability of using these CPUEs as abundance indices entered in the model.

Although the fit assessment was not very good, the knowledge of the fishery status and the results of other assessments carried out in previous years, supports the overexploitation status of the Moroccan stock of *P. acarne*.

Conclusion: The Moroccan stock of *Pagellus acarne* is over-exploited. The freezer cephalopod trawlers CPUE does not seem to be a good indicator of the abundance of this stock.

Sparus spp (*Sparus auriga* and *S. aurata*). Moroccan stock

The populations of the two main sea bream species of *Sparus* spp (*S. auriga* and *S. aurata)* are considered as a single stock. Again, the catch data series is continuous for the Moroccan coastal and cephalopod fleets. For the Moroccan artisanal vessels, catch data are available for 2007 and 2008, while for the Spanish artisanal fleet only 2008 data were available.

For these species, data of CPUE (kg/fishing day) of the cephalopod freezer trawlers and abundance indices recorded in Moroccan scientific survey (1990-2008 series) were attempted to be fitted to the model. The assessment of *Sparus* spp was not possible with the available data, and the poor fit of the model could be explained by the fact that the CPUE and the abundance indices of the surveys did not reflect the actual stock abundance. In addition, the Spanish artisanal fleet data were missed, even if they represented a very little proportion compared with that of cephalopod industrial trawlers fleet.

This problem with the fit was similar in previous assessments attempted by FAO/CECAF Working Groups of 2007 (FAO, 2007) and 2004, even if in that year the stock was in an over-exploited situation (B_{cur}/B_{MSY}= 80%) (FAO, 2006 b).

The evolution of the trends in the cephalopod freezer trawlers' fleet (the main fleet) CPUE series shows, since 2004, a great increase reaching a current yield of 77 kg/fishing day in 2008 (Fig. 1.7). It is worth noting that, even if sea breams (*Sparus* spp) are a by-catch and not targeted species for this cephalopod fleet, they become a target group when more commercially demanded species, such as cephalopods, are not available on the fishing areas. Consequently, their CPUE values are not a reliable indicator of *Sparus* spp abundance.

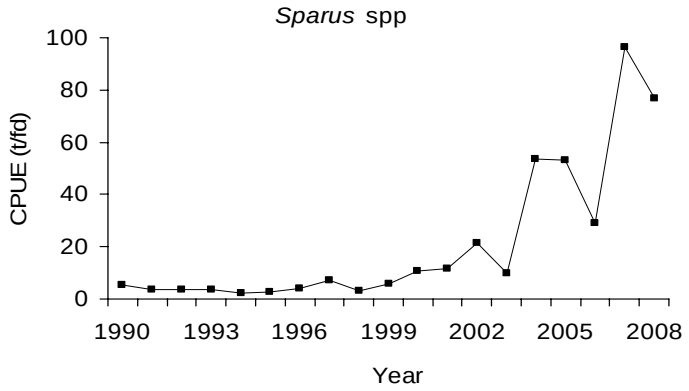

Figure 1.7. CPUE (in tons/fishing day) evolution of *Sparus* spp (*S. auriga* and *S. aurata*) of the cephalopod freezer trawlers in Moroccan waters.

The scientific surveys mainly found *Sparus* spp in Moroccan southern waters, and the overall trend in the average survey abundance indices was fairly similar to that of the commercial CPUEs until 2007 (Fig. 1.8), with low values.

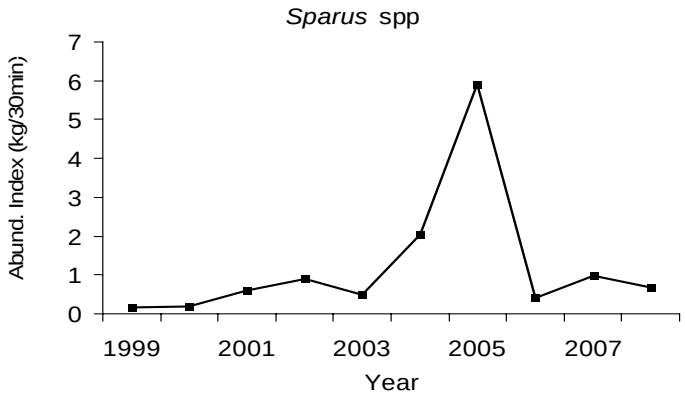

Figure 1.8. Evolution of abundance index of *Sparus* spp (*S. auriga* and *S. aurata*) in Moroccan INRH scientific surveys (R/V Charif Al Idrissi).

Conclusion: The Moroccan stock status of *Sparus* spp is unknown. Abundance indices show a recovery of the stock since 2004.

Pagellus spp (*Pagellus bellottii* and *P. erythrinus*). Moroccan stock

Since the data of the species *Pagellus bellottii* are mixed in Moroccan fishery statistics with other *Pagellus* species (mainly *P. erythrinus*) it was decided to combine them into one group, *Pagellus* spp In previous Working Groups, *P. bellottii* was assessed independently. For assessment purposes, the pandora (*Pagellus* spp) is considered as a single stock in Morocco.

The main catch of *Pagellus* spp is due to the cephalopod freezer trawlers' fleet, but the considered data series also included the Moroccan artisanal landings for some years, and the Spanish artisanal data from 2007 and 2008 (which were quite high in comparison with those of the other seabreams presented here).

Again, as for *Sparus* spp, input data for the assessment were: the CPUE of the cephalopod freezer trawlers and the series of abundance indices from the Moroccan scientific surveys (1990-2008). The results of this 2010 Working Group assessment were rejected, because the model showed a bad fit to data. Thus, the available data did not yield conclusive results for the evaluation of *Pagellus* spp, and neither the CPUE nor the abundance indices from scientific surveys reliably reflected the actual stock abundance. Indeed, pandora seems to become the main fished species when the target ones (such as cephalopods) are not available on the fishing grounds.

Previous assessments of *P. bellottii* yielded variable results: from a fully-exploited status in 2003 (FAO, 2006 a), to an over-exploitation in 2004 (FAO, 2006 b), and heavily over-exploited in 2007 (FAO, 2007). However, the 2007 assessment was carried out with data from fleets operating in Mauritanian and Senegalese waters, but without including Moroccan catch data, but their results were confirmed by the drop, or even collapse, appreciated in the abundance indices obtained from Mauritanian scientific surveys. The regressive trend observed in the indices of abundance both from fisheries and from scientific surveys could be a sign of over-exploitation of this stock.

CPUE (1990-2008) series of Moroccan cephalopod freezer trawlers show a drop since 2005 which is more than twofold of the one recorded in 2004. In 2007 and 2008, the CPUE were at their lowest level of the whole series, due to the low catch values reported in these years (Fig. 1.9).

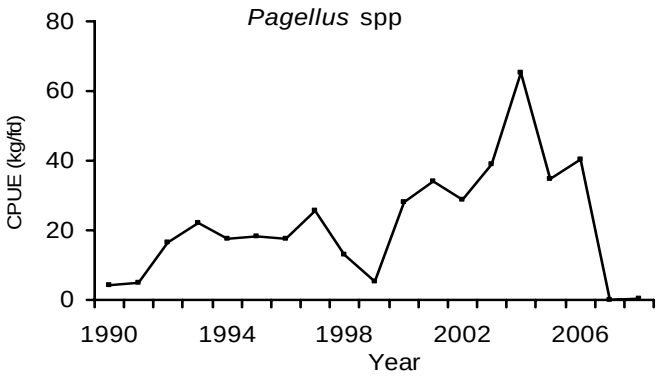

Figure 1.9. CPUE (in kg/fishing day) evolution of *Pagellus* spp (*P. bellottii* and *P. erythrinus*) of the cephalopod freezer trawlers in Moroccan waters.

The abundance indices obtained from Moroccan scientific surveys conducted in waters south of Cape Bojador, where these species are more abundant, showed a decreasing trend for *Pagellus* spp. Yields decreased from a maximum of 65 kg/30min in 2004, to only 4.3 and 3 kg/30min in 2007 and 2008, respectively (Fig. 1.10)

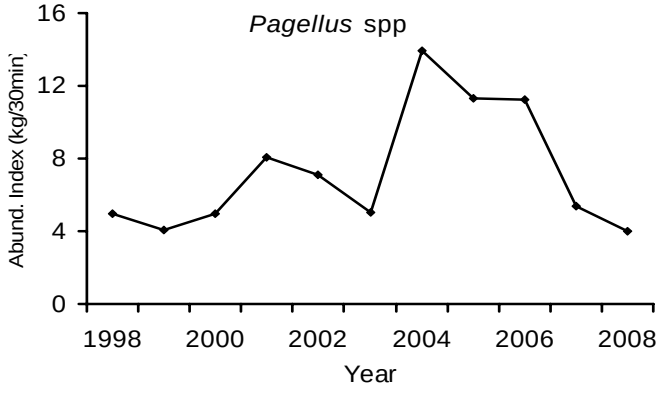

Figure 1.10. Evolution of the abundance index of *Pagellus* spp (*P. bellottii* and *P. erythrinus*) in Moroccan INRH scientific surveys (R/V Charif Al Idrissi).

The decreasing trends observed in the indices of abundance, both from fishery data and from scientific surveys, could be a sign of over-exploitation of the pandora stock.

Conclusion: The Moroccan stock state of *Pagellus* spp is unknown. Abundance indices show a decrease of the stock since 2004.

Dentex macrophthalmus. North West African stock

The large-eye dentex (*Dentex macrophthalmus*) is found in Moroccan, Mauritanian, Senegalese, and Gambian fishing grounds. Due to the lack of detailed and reliable scientific data, the FAO/CECAF Working Group (2010) decided to consider a single stock for the whole sub-region.

The input data for the assessment were: the catch series of *D. macrophthalmus* in waters off Morocco, Mauritania and Senegal, and the abundance indices obtained in the Mauritanian scientific surveys.

Many countries mix the different *Dentex* species with other species of the Sparidae family in the catch. Thus, the reported *D. macrophthalmus* catch values in fact could integrate other *Dentex* species. This causes a mismatch between the reported and the true catch values of the large-eye dentex (*D. macrophthalmus*).

The Working Group envisaged using alternative abundance indices, but as *D. macrophthalmus* is not a targeted species and because the species is found principally in deep waters, it was decided that none of the other abundance indices' data series available to the Working Group would give a reliable indication of the abundance of this species. The Moroccan cephalopod trawlers are a good example of this, because they cover mainly the coastal area up to 100 m depth, where they harvest mostly the juveniles (as observed from the length distribution of the catch, not presented to the Working Group).

The available data were insufficient to produce conclusive results for the assessment of *D. macrophthalmus* stock status. The model did not provide an acceptable fit to the data, hindered by the incoherence between the observed high catch values and the very low abundance indices in recent years.

The CPUE series of the main fleets fishing *D. macrophthalmus* showed different fluctuations over the analysed period. In 2004, the series reached a maximum for the cephalopod freezer trawlers fleet operating in Morocco and Mauritania, but later trends diverged: yields falling drastically in Moroccan waters, and generally increasing in Mauritanian waters (Fig. 1.11).

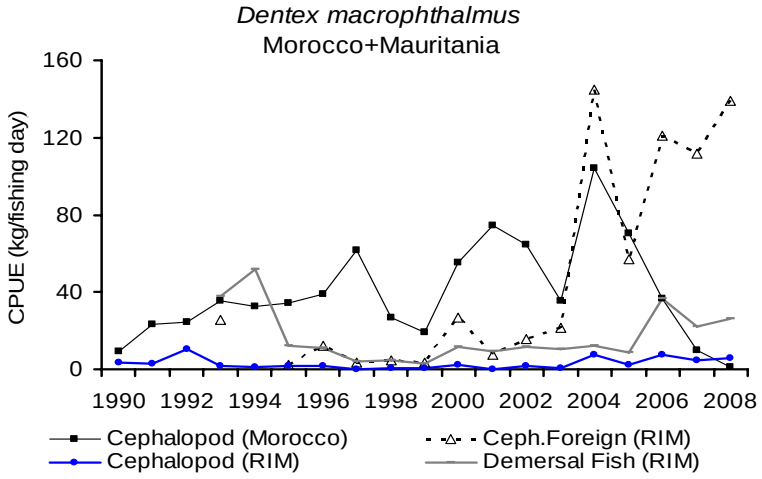

Figure 1.11. CPUE (in kg/fishing day) evolution of *Dentex macrophthalmus* fished by the main fleets in Morocco and Mauritania.

On the contrary, the annual mean catch rates (kg/30 minutes) of *D. macrophthalmus* from research surveys in Mauritania (used as abundance indices input data for the assessment), showed a fluctuating but decreasing trend, achieving very low catch rates from 1995 to 2008 (Fig.1.12).

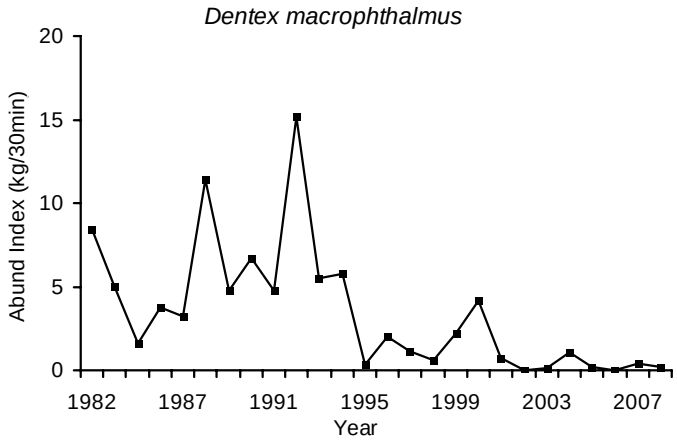

Figure 1.12. Evolution of abundance index (in kg/30 minutes) of *Dentex macrophthalmus* from Mauritanian IMPROP scientific surveys (R/V Al Awan).

Taking into account that the populations of *D. macrophthalmus* are considered as being part of a single stock in the area, and has so been previously assessed, we can extrapolate to Moroccan waters the results of the analyses based on the Mauritanian scientific survey data. The exploitation level must be similar in both countries (probably slightly more intense in Mauritanian waters), since both have national and foreign industrial and artisanal fleets harvesting the large-eyed dentex. However, as the fishery statistics are defective for this species in Moroccan waters, because they do not record the uncontrolled landings (by-catch of Russian fleet and Spanish artisanal vessels from 1990 to 1999) nor the by-catch of all other fleets operating in the area, the available abundance data have to be cautiously analysed. Bearing in mind that the previous stock assessments indicated an over-exploitation of the large-eyed dentex (FAO, 2007), and considering the highest levels of fishing effort exerted over this resource (in spite of its deep habitat), we think that *D. macrophthalmus* stock probably continues to be over-exploited.

Conclusion: The North West African stock state of *Dentex macrophthalmus* is unknown. Abundance indices show contradictory results for the stock since the last decade. The resource is likely over-exploited.

1.1.3. Other demersal fish (finfish and elasmobranchs)

There are no more assessment for the remaining demersal resources of finfish and elasmobranchs. Therefore, we are giving here the available Spanish data (fishery yields and scientific surveys) for species of families Trichiuridae, Sparidae, and Sciaenidae harvested by Spanish fleets from 2007 to 2010 under the last EU-Morocco fishing agreement.

Rajidae (skates)

There is no directed fishery for skates (Rajidae), but they are common by-catch species both in the trawler and in the demersal longline fisheries, even if their catch is not usually recorded. The FAO/CECAF Working Groups have never done stock assessments of these resources.

Skates are potentially fished by all the vessels operating with trawl gears in the area, but the only catch data available are from the Spanish trawlers targeting black hake. However, this fleet has not been operating from 2000 to mid-2007 because there was no EU-Morocco fishing agreement.

Black-hake Spanish trawlers achieved low yields of stakes, since the commercial by-catch of this fleet has always been very low (as already explained in the Introduction section). The data series (Fig. 1.13) shows that the recorded yields for Rajidae ranged from 1 to 51 kg/fishing days. The high yield values recorded in the first year of the return to Moroccan fishing grounds are probably due to the beneficial inactivity of the fleet when the fishery was closed to the EU fleet, as well as because this fleet operates at great depths, over less exploited grounds. These yield data cannot be considered as indices of abundance, because the fleet is not directed for skates, but they can give an idea of the status of the resource.

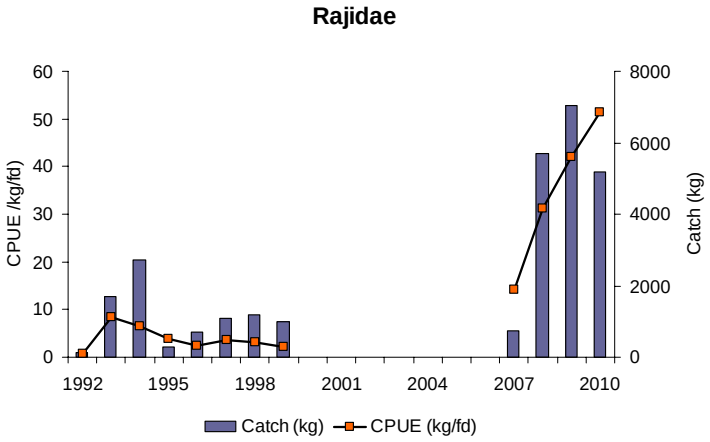

Figure 1.13. Catch (kg) and CPUE (kg/fishing day) of Rajidae from black hake Spanish trawlers in Morocco, 1992-2010 period (2000-2006 without Agreement).

Data of discards or by-catchs are totally unknown in Moroccan fishing grounds, but some data are available for the Mauritanian ones, where the fleet also operates at great depths discarding small amount of skates.

Annual scientific surveys jointly carried out by Spain and Morocco from 2004 to 2007, recorded very low yields for Rajidae. These surveys, carried out each year during the months of November or December, prospected deep sea waters: two of them from 400 to 1800 m, and another two from 200 to 1800 m in south-Sahara. This fact explains the limited representation of Rajidae, as they are more abundant in shallower waters (from 20 m)

We considered all the fished species belonging to Rajidae family as a whole, because not only *Raja* spp is of commercial interest. In addition, the taxonomical uncertainties about this family also advise this grouping. The Rajidae catches in the surveys were very low, despite this family has a wide bathymetrical distribution with shallow water species (*Raja miraletus* and *Leucoraja naevus*) and deep water species (*Rajella barnardi*, *Leucoraja circularis,* and *Dipturus batis*). All these species are of commercial interest for the black hake Spanish trawlers. Both low catch and yields suggest that Rajidae have limited reproductive capability and are very vulnerable to indiscriminate fishing. Due to the number of fleet potentially exploiting this resource at different depths, the stock of skates is probably over-exploited, at least in the shallowest fishing grounds easily accessible to all the trawlers fleets.

Scianidae (croakers)

This resource is exploited by all the artisanal fleets (both Moroccan and Spanish), and by the Moroccan coastal fleets (trawlers and longliners, but also the more artisanal gears such as entangling and trammel nets).

The resources have never been assessed in the area, because the only available data are those from the Spanish artisanal fleet from the Canary Islands. Artisanal Canary Islands fleet operates south of 30º 40' N and beyond 3 nautical miles. The most representative species among Sciaenidae is the croaker (*Argyrosomus regius*), whose catch are very low, accounting for only 3.25% of the total catch recorded from 2007 and 2010 (when the fishing activities were resumed in Moroccan southern waters after the signature of a new fishing agreement). Figure 1.14 shows the yields recorded for this family before the previous fishing agreement came to an end in 1999, and for the recent years. Current values are among the minimum ones.

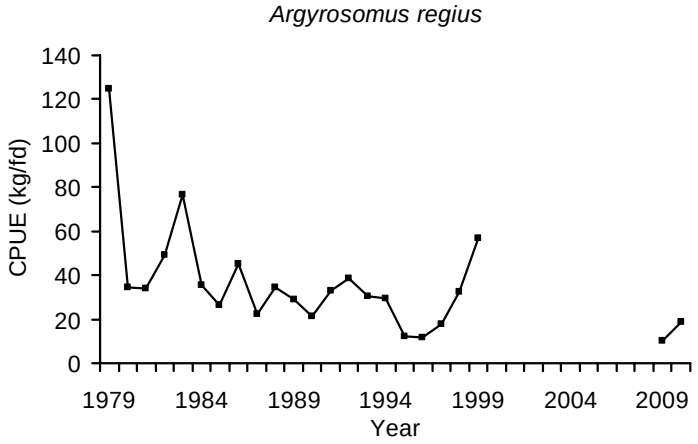

Figure 1.14. CPUE (in kg/fishing day) evolution of *Argyrosomus regius* of the artisanal Spanish fleets operating at the South of Morocco (2000-2006 without fishing agreement in force).

This resource is distributed very close to the coastline and is found between 15 and 200 m. Thus, the hundreds of pirogues and canoes of the artisanal Moroccan fleet are likely to be heavily exploiting this resource with little or no control. The Moroccan coastal trawlers and the longliners are probably exploiting this resource, but at a totally unknown level. If the low yields achieved by the Spanish artisanal fleet from the Canary Islands are confirmed, the croaker is probably an over-exploited resource, very complex to manage and requiring the implementation of technical management measures (such as closed areas and/or seasons) for the artisanal and coastal Moroccan fleets.

Trichiuridae (scabbard fishes)

The Spanish artisanal fleet at the North of Morocco is the only fishery targeting the family Trichiuridae (scabbard fishes) and highly specialised, achieving a percentage of 84% of their catch, followed by the family Sparidae, accounting for 10% . As it is a very limited fishery, the resource has never been assessed. In 2008 and 2009 the average catch of Trichiuridae was of 250 t.

This family is certainly exploited by the Moroccan coastal fleet. Furthermore, it must account for a significant percentage of the discards of other fleets operating in Moroccan waters. The main species are the black scabbardfish (*Aphanopus carbo*),a deep-water species (200-1700 m), the largehead hairtail (*Trichiurus lepturus*), a shallower species (100-350 m), and the silver scabbardfish (*Lepidopus caudatus*), a big sized species found in intermediate depths (40-600 m). The juveniles of these species (mainly those of the last 2 species) form big schools in shallow waters, where they are easy preys for the coastal trawler vessels.

The yields of these species have been estimated from the Spanish artisanal fleet from 2007 to 2009, when the Spanish vessels returned to the Moroccan fishing grounds under the new fishing agreement. The fishery statistics for this fleet are not available for the years before 1999 (when the fishing agreement came to an end). The most recent data (2009) recorded total catch values comprised between 150 and 700 kg/fishing trip, depending of the vessel type, and the maximum yields corresponded to the Trichiuridae family (to 687 kg/fishing day) (Presas, 2011 b).

Sharks

As for the skates, there is no directed fishery for sharks, but they are common by-catch species both for the trawlers and in the demersal longliners fisheries, even if their catch is not usually recorded. Therefore, this resource has never been assessed.

The only available data are those of Spanish trawlers targeting black hakes. Sharks are important by-catch species for this fleet, although they only averaged 0.4% of the total catch (from 2007 to 2010). In fact, this fleet is interested in landing large volumes of black hake (as explained in the introduction) and reduced amounts of by-catch (between 1% and 9%). Among the reduced by-catch and during the same period, the sharks accounted for 6%. In the historical fishery database (1992-1999 and 2007-2010), the yields of this resource have ranged from almost null values to 34 kg/fishing day (Fernández *et al*., 2004), which represent an average catch of 270 kg/fishing trip.

Figure 1.15 shows the shark catch and yield values for the black hake trawlers. This CPUE cannot be regarded as an abundance index, since the sharks are not target species for this fleet. However, if we assume that this fleet has not changed its fishing strategy, this data series can give an idea of the trend. The significant increase observed, both in catch and yields, in 2008 and 2009, could be regarded as an abundance increase, but we know that the fleet is targeting big-sized hake specimens in deeper waters, where the shark resources are more abundant because less exploited. In this case, the increasing trend would be due to the catch of no much exploited (and thus more abundant) shark populations. As seen in the figure, the vessel only operated in the fishing area for some months (2 or 3), both in 2007 (year of signature of the fishing agreement) and in 2010 (due to the sinking of the vessel in May).

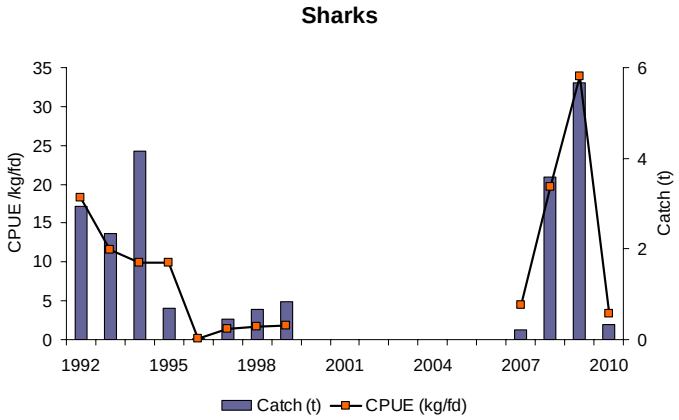

Figure 1.15. Catch (kg) and CPUE (kg/fishing day) of Sharks from black hake Spanish trawlers in Morocco, 1992-2010 period (2000-2006 without fishing agreement in force).

The deep sea prospecting scientific surveys jointly carried out by Spain and Morocco each year in November or December, from 2004 to 2007, recorded the catch of the following shark species (in order of importance in the catch): *Centrophorus* spp (mainly with *C. granulosus* but also *C. squamosus*), and *Deania calcea*, and *Centroscymnus coelolepis*. All these species are included in the IUCN as vulnerable species.

1.2. MAURITANIAN STOCKS

1.2.1. Hakes

Merluccius senegalensis and *Merluccius polli.* Mauritanian stock

The black hake (*M. polli* and *M. senegalensis*) stock status in Mauritania was assessed during the last FAO/CECAF Working Group on the Assessment of Demersal Resources (Subgroup North), carried out in Agadir (Morocco) in February 2010 (FAO, 2010). Again, the Schaefer dynamic production model and its fitting were implemented into a MS Excel spreadsheet under the BIODYN package (Punt and Hilborn, 1996; Barros, 2007).

The input data were the total catch series of black hake corresponding to all directed fleets (Spanish trawlers, Spanish longliners and Mauritanian trawlers), as well as the black hake by-catch of the Spanish freezer trawlers. The CPUE of the Spanish trawlers was the longest available series (1983 to 2008), used as abundance indices. As already explained, both species are mixed in catches and are commonly marketed as *Merluccius* spp. Thus, the available catch data correspond to the fished amount of the two species, even if almost 90% of the catch is of *M. polli* (the species with deeper bathymetrical range) due to the fishing strategy of the fleet, harvesting black-hake between 40 and 800 m. Thus, the estimation is carried out as a single stock, as was always done in previous assessments of this resource. The model was fitted to data taking into account the presumable environmental effects on the abundance of the stock over the period 1997-2000, according to the studies on the influence of the North Atlantic Oscillation (NAO) on the abundance of hakes in the North West African coast (Meiners *et al.*, 2010).

The model gave a satisfactory fit and the results showed that the stock was not fully-exploited. The current biomass (B_{cur}), in the last year of data, exceeded the target biomass ($B_{0.1}$). The current effort (F_{cur}) was lower than the target effort ($F_{0.1}$), that corresponds to the target biomass (Table 1.V).

Table 1.V. Indicators of the stock status of *Merluccius* spp of Mauritania, according to the estimated Reference Points (dynamic production model).

Stock/abundance index	**F_{cur}/F_{SYcur}**	**$B_{cur}/B_{0.1}$**	**$F_{cur}/F_{0.1}$**	**B_{cur}/B_{MSY}**	**F_{cur}/F_{MSY}**
Merluccius spp/CPUE Spanish trawlers (1983-2008)	71%	132%	43%	145%	39%

F_{cur}/F_{SYcur}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the fishing mortality coefficient that would provide a sustainable catch at the current biomass level.
$B_{cur}/B_{0.1}$: Relationship between the biomass estimated for the last year and the target biomass.
$F_{cur}/F_{0.1}$: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the target effort.
B_{cur}/B_{MSY}: Relationship between the biomass estimated for the last year and the biomass that would provide the Maximum Sustainable Yield (MSY).
F_{cur}/F_{MSY}: Relationship between the fishing mortality coefficient effectively observed in the last year of the series and the fishing mortality coefficient that would provide the Maximum Sustainable Yield (MSY).

Figure 1.16. graphically depicts the status of the stock.

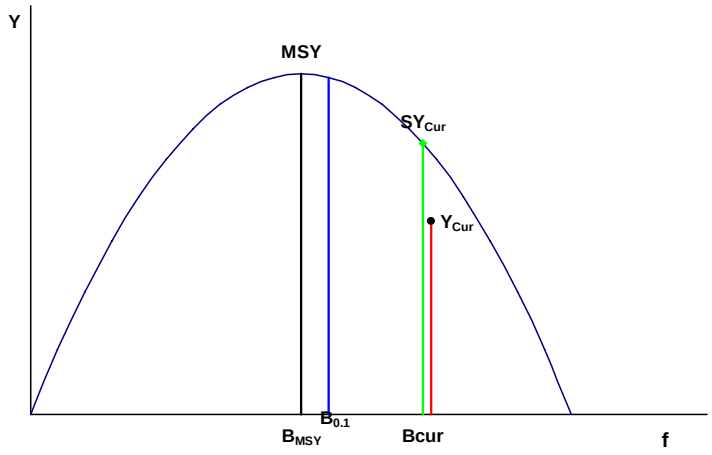

Figure 1.16. Graphical presentation of the status of the stock and the fishery of *Merluccius* spp in Mauritanian waters in the last year considered (1999), in relation to the Reference Points estimated for the stock.

The result of this last assessment was different from the result obtained in the FAO/CECAF assessment Working Group of 2007 (FAO, 2007), which concluded that the Mauritanian black hake stock was over-exploited. In fact, the explanation of this difference is simple: an independent Working Group, focused on the revision of the IEO, IMROP and CRODT fishing databases changed some of the data values, producing the new input database for the 2010 assessment. This last assessment is regarded as coherent and reliable, since there has been an observable decline in

the fishing effort exerted over this resource in recent years, and the model fitted better to 2010 data (Pearson R=0.84) than to 2007 ones.

The Working Group attempted two more assessments: a separate assessment of the black hake resources in waters off Senegal-Gambia, and a joint assessment for Mauritania-Senegal-Gambia (under the assumption of a black hake single stock for the whole area), using the CPUE of the Spanish trawlers operating in Mauritania. The results showed that the stocks of black hake were not fully-exploited in all areas.

The FAO/CECAF Working Groups (FAO, 1979; 1989; 1990; 1997; 1999; 2006a-b; 2007) have been concerned with the state of the Mauritanian stock of black hake, and the several assessments attempted have yielded different results: fully-exploited, over-exploited, moderately exploited (FAO, 1997), or impossible to assess. However, the level of the black hake exploitation has always been below those of European hake.

The results of the 2010 assessment must be interpreted with caution, because even if the fishery statistics have been improved in recent years, they still show some deficiencies, such as the non-availability of the total black hake by-catch (both marketed and discarded) corresponding to all the fleets operating in the area.

Conclusion: The Mauritanian stock of *Merluccius* spp (*Merluccius polli* and *M. senegalensis*) is not fully-exploited.

1.3. GUINEA-BISSAUAN STOCKS

Currently, there are not European industrial fisheries specifically targeting demersal fin-fish resources in waters off Guinea-Bissau. However, ir is well known that other non EU foreign fleets (mainly Chinese) harvest great amounts of finfish, even working with shrimps or cephalopod licences. Furthermore, we ignore the harvesting level exerted by the artisanal fisheries over these resources, because there are no fishery statistics. In absence of statistical databases, it is impossible to carry out the assessment of the demersal fish resources in Guinea-Bissauan waters.

1.3.1. Hakes

Merluccius polli. Guinea-Bissauan stock

As said above, in Guinea-Bissau there are no fisheries targeting black (Benguela) hake (*Merluccius polli*), but this species is a major by-catch of some fleets in certain moments. As it is not a targeted species, it has never been assessed in Guinea-Bissauan fishing grounds.

As the by-catch of black hake is not systematically recorded, the only catch series without gaps (from 2006 to 2010) corresponds to the Spanish cephalopod trawlers fleet. For the other EU and non-EU foreign fleets, data are insufficient or with significant gaps. In addition, those catch data do not allow the estimation of reliable CPUE values, because it is not a directed fishery for Benguela hake.

The only information about the *M. polli* stock state in Guinea-Bissau comes from the direct assessment provided by two demersal trawl prospection surveys. These scientific surveys were jointly carried out by the Spanish IEO (Instituto Español de Oceanografía) and the Guinea-Bissauan CIPA (Centro de Investigaçao Pesqueira Aplicada), into the Framework of the bilateral cooperation

agreements. These surveys were both carried out in autumn in 2002 and 2008, and they sampled the continental shelf and slope grounds between <50 and 1000 m, according to a randomly stratified sampling scheme. As the Guinea-Bissauan waters are the southern geographic limit of *M. senegalensis*, its occurrence during both demersal surveys has been very little. The biomass estimates for the whole area were 2.5 and 94.5 t in 2002 and 2008, respectively (we have to mention that despite the highest value recorded for 2008, *M. senegalensis* only occurred in a single fishing station).

The comparison between the biomass values show an alarming decrease, being the recorded biomass of 2008 more than ten times lower than the 2002 (Table 1.VI).

Table 1.VI. Estimated biomass (t) of *Merluccius polli* off Guinea-Bissau. Data obtained in two demersal surveys (October 2002 and 2008) onboard Spanish R/V Vizconde de Eza.

Survey	BIOMASS (t)
BISSAU 0210	10633
BISSAU 0810	903

Benguela hakes were always fished at waters deeper than 50.The Spanish cephalopod trawlers have yielded high catches of *M. polli* from 2007 and 2009, much higher than the catch of the other EU and Chinese fleets (whose catch levels of this species are almost negligible). In fact, the Spanish cephalopod trawlers declared a by-catch (mostly fish) of 71% of their total catch (Anonymous, 2010), of which *M. polli* accounted for more than 20%. We also must bear in mind the existent of unknown levels of undeclared by-catch (i.e., the Chinese fleet, with a higher percentage of by-catch than the Spanish cephalopod trawlers, is not declaring any hake catch). We also know that, in recent years, some freezer trawlers from joint ventures achieved high catches of hake (to be processed onboard). Finally, the discarding of the small-sized hake individuals by all fleets must also be a significant part of the unknown catch of this species. For all these reasons, we think that the actual available data of *M. polli* catch in Guinea-Bissauan waters are greatly under-estimated.

Conclusion: The exploitation state of the *Merluccius polli* stock of Guinea-Bissau is unknown. The biomass showed a great decrease in 2008 with respect to 2002. The over-exploitation is suspected.

1.3.2. Other Demersal Finfish

Pagellus spp and other Sparidae. Guinea-Bissauan Stock

This group of species is not officially reported, either by EU or by Chinese fleets. The only available data concerning *Pagellus* spp come from the above mentioned two trawl demersal prospection surveys carried in Guinea-Bissauan waters. The only species of this genus fished in both surveys was *Pagellus bellottii bellottii* (a more tropical species among the genus), the second (2002 survey) and third (2008 survey) most important species, in terms of biomass of the sea breams' group. Table 1.VII presents the estimated biomass for the total surveyed area.

Table 1.VII Estimated biomass (t) of *Pagellus bellottii* off Guinea-Bissau. Data obtained in two demersal surveys onboard Spanish R/V Vizconde de Eza.

Survey	BIOMASS (t)
BISSAU 0210	1365
BISSAU 0810	1968

The biomass of this species has increased between both surveys, which could be indicative of an improvement of the stock health. However, in the 2008 survey, the caught individuals were smaller in size than those of the 2002 survey. The surveys also evidenced an increase of the biomass of the whole group (except *P. bellottii*) of the sea breams (Sparidae). The caught species of this group were mainly those belonging to genus *Dentex* (in 2008: *D. maroccanus*, *D. congoensis,* and *D. angolensis)* and *Pagrus coeruleostictus*. The average sizes of these species increase from one survey to another.

Table 1.VIII Estimated biomass (t) of *Sparidae* off Guinea-Bissau. Data obtained in two demersal surveys (October 2002 and October 2008) onboard Spanish R/V Vizconde de Eza.

Survey	BIOMASS (t)
BISSAU 0210	11315
BISSAU 0810	13933

Chinese vessels, both targeting shrimps and cephalopods, declare high catches of *Dentex,* but due to the multi-specificity of these fleets, these catches only account for 3%-5% of the total catch. The Spanish cephalopod trawlers declared 161 t of *Dentex* spp in 2007, which amounted almost 3% of the total catch.

Dentex spp are amongst the most valued sea bream species, and so is highly targeted by the illegal, unreported and unregulated fisheries (IUU), even if there are no evidences for that. All the mentioned considerations let us think that the scarce actual available catch data of Sparidae in Guinea-Bissauan waters is greatly under-estimated.

Conclusion: The state of the *Pagellus bellotti* and the Sparidae family stocks of Guinea-Bissau are unknown. Their biomass increased in 23% from 2002 to 2008. Due to the lack of information about these species, the results should be considered with great caution.

Solea spp. Guinea-Bissauan Stock

The species of the genus *Solea*, such as *Solea senegalensis* or *Pegusa lastaris* (*Solea lascaris, senior synonym)*, even if reported as living in Guinea-Bissauan waters, were not fished during the two already mentioned demersal trawl prospection surveys. These species are not even recorded in the official Guinea-Bissauan fishery statistics of the CIPA. Therefore, we think that the species marketed as "soles" are not really *Solea* spp but other Pleuronectiformes belonging to families Cynoglossidae (*Cynoglossus canariensis, C. monody* and *C. browni)* and Soleidae *(Dicologoglossa hexophthalma*, *D. cuneata, Microchirus frechkopi* and *M. variegatus)*.

Contrariwise to hakes, flatfishes are caught by all fleets and in percentages of the total catch averaging (period 2007-2009) from 8% (EU shrimpers) to 14% (Spanish cephalopod trawls). The multi-species Chinese fleets, no matter of the fishing category, this percentage ranges from 9% to 16%. In Guinea-Bissau there is a multi-specific fishing category for fleets targeting finfish (see Introduction 3.2). Probably, the fleets which chose this licence are those targeting flatfish.

Due to the uncertainty about these data, and in absence of studies about the specific composition of the flatfish caught by these freezing fleets (that process the catch onboard), we analyse the data of the total biomass of the Pleuronectiformes recorded in the surveys carried out in the area in 2002 and 2008 (Table 1.IX).

Table 1.IX. Estimated biomass (t) of Pleuronectiformes off Guinea-Bissau. Data obtained in two demersal surveys (October 2002 and October 2008) onboard Spanish R/V Vizconde de Eza.

Survey	BIOMASS (t)
BISSAU 0210	4004
BISSAU 0810	3657

The 2008 biomass values are slightly (9%) lower than those estimated in 2002, but we do not have enough knowledge on the biology of this group of species to accurately and reliably interpret these values. In addition, we ignore the basic facts of the different fleets operating in the area.

Conclusion: The state of the Pleuronectiformes group of Guinea-Bissau is unknown. The biomass was 9% lower in 2008 than in 2002.

2. ARE THE EU FLEETS TARGETING DEMERSAL HAKE AND OTHER FISH SPECIES (FINFISH AND ELASMOBRANCHS) PRESENTLY FISHING THE SURPLUS OF THE EXPLOITED RESOURCES?

The coastal states shall determine its capacity to harvest the living resources of the Exclusive Economic Zone (EEZ). Where the coastal states do not have the capacity to harvest the entire allowable catch, it shall, through agreements or other arrangements and pursuant to certain terms, conditions, laws and regulations, give other states access to the **surplus of the allowable catch** (UNCLOS, 1982[7]).

To answer the question addressed in this point, we have to review all the assessments explained in the previous section and determine if there is a surplus of the allowable catch be available to European fleets.

The current biomass, B_{cur} (referred to the last year of data), estimated by the e dynamic production model (BIODYN package) produces a sustainable yield (CSY) that corresponds to the surplus of any stock. The resource extraction carried out by national fleets (if any) has to be deducted from the surplus to estimate the remaining allowable catch surplus available to other foreign fleets (EU and non-EU) foreign). If the production of the system reaches a Maximum Sustainable Yield (MSY), then the surplus production, once the national catches have been subtracted to MSY, should be the value available for other fleets. To have a surplus stock and a sustainable production, the available biomass (B_{cur}) should be higher than the biomass that produces MSY (B_{MSY}).

2.1. MOROCCAN STOCKS

2.1.1. Hakes

Merluccius merluccius. Moroccan stock

The fishing agreement currently in force does not provide fishing licences to any EU fleet targeting the European hake (*M. merluccius*) with any fishing gear. This resource is only targeted by the Moroccan coastal fleet and by longliners operating as joint ventures. The activity of the joint ventures fleet is totally unknown. Table 2.I shows the catch of the Moroccan coastal fleet, exploiting 100% of the Moroccan stock of *M. merluccius*. However, at the moment there are no EU fleets targeting this resource Therefore, we present here the current *M. merluccius* Moroccan stock status to assess the fishing possibilities for an EU fleet that could be eventually allowed to target this species in the future.

[7] Surplus, as defined by UNCLOS - UN, United Nations Convention of the Law of the Sea of December 1982, Part V: Exclusive Economic Zone.

Table 2.I. Catch (tons) of *Merluccius merluccius* in Morocco over the period 2004-2008, with average values by fleet.

Fleet\Year	2004	2005	2006	2007	2008	Average	%
Moroccan coastal fleets	10036	8745	5623	5981	4209	6919	100

The results of the last assessment (2010) indicated that the Moroccan stock of *M. merluccius* was heavily exploited, in terms of biomass. Thus, no surplus is available to be harvested by any fleet.

The current biomass (referred to 2008) was around 17 100 t, and produced a sustainable yield of 1730 t. This is the surplus of European hake. The average catch of Moroccan coastal fleets (the only fishing this resource) was 6919 t, largely above the estimated surplus production. This means that the Moroccan coastal fleet is currently fishing well above both the sustainable production (CSY) and the Maximum Sustainable Yield (MSY) of the stock. Consequently, and according to the estimated parameters (Table 2.II), there is no resource available to be exploited by any fleet. For this resource, the current biomass (17 100 t) is lower than the biomass of the MSY (27 200 t), and in these conditions is impossible to have any surplus.

Assuming that the catch level is underestimated, because the data considered for the assessment were missing the catch data of the joint ventures longliners, the significant by-catch of European hake made by other fleets, and the certainly relevant discards, according to the model we can think that the stock of *M. merluccius* is about to collapse in Moroccan waters (Table 2.II).

Table 2.II. Parameters of *Merluccius merluccius* production in Moroccan waters, as estimated by the model and used as indicators of the surplus production. Differences between these indicators and the catch made by the Moroccan fleet from 2004 to 2008 (Mor. Average Catch).

Parameters (*M. merluccius*)	Value (t)
CSY	1730
MSY	2007
Moroccan Average Catch (2004-2008)	6919
CSY – Mor. Average Catch	-5189
MSY – Mor. Average Catch	-4912

CSY= Current Sustainable Yield
MSY= Maximum Sustainable Yield
Mor. Average Catch = Average catch values by the Moroccan Fleet during the period 2004-2008.
CSY - (Mor. Mean Catch) = Surplus at the current year (last year of the assessment).
MSY- (Mor. Mean Catch) = Surplus in a equilibrium situation (MSY level)

Conclusion: The Moroccan fleet is currently fishing well above both the surplus of the current sustainable yield and the MSY, and considering the data of the last assessment, there was not surplus of *M. merluccius* to be fished by any fleet.

Merluccius senegalensis and *Merluccius polli.* Moroccan stock

The Moroccan black hake stock has been exploited until May 2010, when the last Spanish vessels left the fishery. Now, there is no EU fleet currently targeting black hake. However, we are unable to evaluate whether the EU fleet was actually fishing the surplus of this resource over the last years, because its assessment was carried out in 2003. Since 2003, there is also a Moroccan fleet fishing for black hake, whose catch proportion was 60% more important than those of the Spanish trawlers from 2007 to 2008, when the black hake EU fleet returned to the Moroccan fishing grounds (Table 2.III).

We cannot assess which proportion of the surplus could be caught by Spanish fleet, since the resource has not been assessed in recent years. Therefore, we do not have any estimated parameter, such as the MSY for the current series of catch and CPUE, referred to last year.

Table 2.III. Catch (t) of *Merluccius* spp. (*Merluccius polli* and *M. senegalensis*) in Morocco over the period 2003-2008, with average values and percentages by fleet.

Fleet\Year	2003	2004	2005	2006	2007	2008	Average	%
Spanish fleets (trawlers)					170	692	431	30
Moroccan coastal fleet	1027	1711	1179	793	557	785	1009	70

However, we have estimated the surplus corresponding to the year considered in the last assessment (1999), when the Spanish fleet ceased its fishing activities, because the fishing agreement came to an end. As the Spanish fleet was not operating anymore from 2000 to 2006, the estimated surplus has probably not been harvested by any fleet until 2003, when the Moroccan coastal fleet stars to declare black hake.

Table 2.IV shows the average values of the *Merluccius* spp. catch for different Spanish fleets (by the time, the only existing fisheries targeting black hake in Morocco over the period 1995 to 1999 (the five last years of the used database).

Table 2.IV. Catch (t) of *Merluccius* spp. (*Merluccius polli* and *M. senegalensis*) in Morocco over the period 1995-1999 with average values and percentages by fleet.

Fleet\Year	1995	1996	1997	1998	1999	Average	%
Spanish trawlers	128	601	957	1608	1383	935	31
Spanish longliners	82	1136	2059	2527	1990	1559	52
Spanish gillnetters	160	797	856	464	278	511	17

The BIODYN package estimated the parameters enabling the estimation of the surplus: Spanish fleet was catching 88% of the MSY, leaving a surplus of 417 t (Table 2.V).

Table 2.V. Parameters of *Merluccius* spp. (*M. polli* and *M. senegalensis*) production in Moroccan waters, as estimated by the model and used as indicators of the surplus production. Differences between these indicators and the catch of the Spanish fleet over the period 1995-1999 (Span. Average Catch).

Parameters (*Merluccius* spp)	**Value (t)**
CSY	3422
MSY	4729
Spanish Average Catch (1995-1999)	3005
CSY – Span. Average Catch	417
MSY – Span. Average Catch	1724

CSY= Current Sustainable Yield
MSY= Maximum Sustainable Yield
Span. Average Catch = Average catch values by the Spanish Fleet over the period 1995-1999.
CSY - (Span. Mean Catch) = Surplus at the current year (last year of the assessment).
MSY- (Span. Mean Catch) = Surplus in an equilibrium situation (MSY level)

The 2003 assessment (FAO, 2006a), showed a clear over-exploitation of the black hake Moroccan stock, with the biomass for the last year of the series (B_{cur}) being around half of the one producing the maximum sustainable yield (B_{MSY}). The sustainable yield (SY) value was lower than the MSY value, evidencing the existence of problems of surplus availability. However, the closure of the fishery for 3 years has probably had a benefit on the resources, whose surplus has been unused for those all years.

Conclusion: With the available information, we can not estimate if the EU fleet is currently fishing the surplus of the Moroccan *Merluccius* spp. (black hake) stock. Nevertheless, we suspect the existence of a surplus that could be exploited by the EU fleet.

2.1.2. Other Demersal fish (finfish and elasmobranchs)

Pagellus acarne- Moroccan stock

In the area, the main catch of *P. acarne* is landed by the Moroccan fleets, composed both of industrial cephalopod freezer trawlers, and coastal trawlers capturing this resource as by-catch. There is also a Moroccan directed artisanal fleet. The Spanish artisanal vessels began their fishing activities in 2007, under the new fishing agreement, but their catch only account for 0.05% of the total catch (Table 2.VI).

Table 2.VI. Catch (t) of *Pagellus acarne* in Morocco over the period 2004-2008 with average values and percentages by fleet.

Fleet\Year	**2004**	**2005**	**2006**	**2007**	**2008**	**Average**	**%**
Moroccan freezer trawl	657	598	628	53	170	421	17
Moroccan coastal fleet	1531	1298	1356	3569	2494	2050	83
Moroccan artisanal				0.16	2.3	1.2	0.05
Spanish Artisanal				1.4	1.2	1.3	0.05

The results of the last assessment in 2010 showed that the Moroccan stock of *P. acarne* was over-exploited. Although the fit of the model was not good to the catch and CPUE data series, the assessment was accepted by the WG, based on the knowledge of the fishery and the results of previous assessments, with better fits. This last assessment estimated current biomass (B_{cur}, referred to 2009) was of 4582 t and would produce a sustainable yield of 1933 t (Table 2.VII). The Moroccan mean catch is much higher than this surplus, so there are no available *P. acarne* resources to be exploited by any other fleet. In this case, there is an availability problem because the estimated B_{cur} is lower than the biomass achieving the MSY (B_{MSY}=13 027 t). The implementation of adequate management measures (such as closed areas for cephalopod trawlers) could improve the *P. acarne* stock state, and only if the fishery would reach equilibrium or fully-exploitation (MSY) there would be a surplus of the allowable catch to be harvested by Spanish artisanal vessels.

Table 2.VII. Parameters of *Pagellus acarne* production in Morocco waters, estimated by the model and used as indicators of the surplus production. Differences between these indicators and the Moroccan fleet' catch from 2004 to 2008 (Mor. Average Catch).

Parameters (*Pagellus acarne*)	**Value (t)**
CSY	1933
MSY	3335
Moroccan Average Catch (1995-1999)	2471
CSY – Mor. Average Catch	-538
MSY – Mor. Average Catch	864

CSY= Current Sustainable Yield
MSY= Maximum Sustainable Yield
Mor. Average Catch = Average catch values by the Moroccan Fleet during the period 2004-2008.
CSY - (Mor. Mean Catch) = Surplus at the current year (last year of the assessment).
MSY- (Mor. Mean Catch) = Surplus in an equilibrium situation (MSY level)

Conclusion: The Moroccan fleet is currently fishing well above the current sustainable yield and, as estimated by the last assessment, there was not surplus of *P. acarne* available for the EU fleet.

***Sparus* spp. (*Sparus auriga* and *S. aurata*) and *Pagellus* spp. (*Pagellus bellottii* and *P. erythrinus*). Moroccan stocks, and *Dentex macrophthalmus*. North West African stock**

These sea breams species could not be assessed by the 2010 FAO/CECAF Working Group, due to a bad fit of the model to the catch and CPUE data series (see section 1). Therefore, there are no estimations of the parameters to know whether a surplus exists for these stocks.

Thus, we only present here the different catch data and their average values and percentages of the total catch by fleet. (Table 2.VIII)

Table 2.VIII. Catch (t) of *Sparus* spp. and *Pagellus* spp. in Morocco, and *Dentex macrophthalmus* in North West Africa, from 2004 to 2008, with average values and percentages by fleet.

***Sparus* spp (*Sparus auriga* and *S. aurata*) – Moroccan stock**							
Fleet\Year	**2004**	**2005**	**2006**	**2007**	**2008**	**Average**	**%**
Moroccan freezer trawl	1320	2385	1149	3720	3412	2397	84
Moroccan coastal fleet	97	835	934	205	149	444	16
Moroccan artisanal	na	na	na	3	8	5	0.18
Spanish Artisanal	-	-	-	0	6	3	0.11
***Pagellus* spp (*Pagellus bellottii* and *P. erythrinus*) – Moroccan stock**							
Fleet\Year	**2004**	**2005**	**2006**	**2007**	**2008**	**Average**	**%**
Moroccan freezer trawl	1611	1563	1600	2	13	958	73
Moroccan coastal fleet	69	134	149	366	531	250	19
Moroccan artisanal	105	150	152	0.7	45	90	6.4
Spanish Artisanal	-	-	-	11.2	31.6	21	1.6
***Dentex macrophthalmus* - North West African stock**							
Fleet\Year	**2004**	**2005**	**2006**	**2007**	**2008**	**Average**	**%**
Moroccan freezer trawl	2574	3161	1451	372	47	1521	75
Moroccan coastal fleet	324	640	477	294	717	490	24
Moroccan artisanal	13	4	0	33	7	11.4	0.6
Spanish Artisanal	-	-	-	0.2	0.1	0.15	0.01

As shown in the Table 2.VIII, almost the entire catch of all the considered species is due to the Moroccan cephalopod freezer trawlers, which fish these species as by-catch, and to the Moroccan coastal fleet.

Moroccan and Spanish artisanal fleets target these species but have much less incidence over them. In comparison, the Spanish fleet catch is almost negligible, with average percentages of the total catch ranging from 0.01% (*D. macrophthalmus*) to 1.6% (*Pagellus* spp.) (Table 2.VIII).

Conclusion: We have not enough data to estimate the surplus production of these stocks, neither in Morocco nor in the whole area, as we ignore the current stock status of the species. In comparison with the Moroccan national fleets, the exploitation of these resources is negligible by the EU fleet.

Trichiuridae and Sciaenidae. Moroccan stock

The stock status of these resources has never been assessed, and the only available data are those of the Spanish artisanal fleet in recent years (2007-2009). The catch data of the other fleets are totally unknown, but the artisanal and coastal Moroccan fleets are certainly fishing these resources as by-catch (both marketed and discarded), but are not reporting them.

Conclusion: We cannot estimate if the EU is fishing the surplus of these stocks, due to the lack of general nformation of the species, mainly caught as by-catch.

Rajidae and Sharks (elasmobranchs). Moroccan stocks

There are no directed fisheries for elasmobranchs. Thus, the only available fishery data about this group of species come from the by-catch of the Spanish black hake trawlers. Among the elasmobranchs, the main caught species have deep bathymetrical distribution ranges (see section 1), and are probably not fished by any other fleet, except the Moroccan coastal fleet since 2004 (when this fleet began the fishing for black hake). However, we totally ignore the species and their catch levels of this Moroccan fleet. Due to the lack of data, the stock status of the elasmobranchs resources has never been assessed.

Conclusion: We cannot estimate if the EU is presently fishing the surplus of these stocks due to the lack of information.

2.2. MAURITANIAN STOCKS

2.2.1. Hakes

Merluccius senegalensis and Merluccius polli. **Stock Mauritania**

The Mauritanian stock of black hakes (*M. polli* and *M. senegalensis*) is targeted by different fleets, being the Spanish the most important one. Table 2.IX shows the catch data of these fleets over the period 2004-2008. For the last years, data are not available for the Mauritanian fleet. Currently, the Mauritanian and other nationalities trawlers targeting black hake have disappeared.

The results of the last assessment (FAO, 2010) showed that, as the stock is not fully-exploited, there is a sustainable production surplus that can be exploited.

Table 2.IX. Catch (t) of *M. polli* and *M. senegalensis* in Mauritania over the period 2004-2008 with average values and percentages by fleet.

Fleet\Year	2004	2005	2006	2007	2008	Average	%
Spanish fleets (trawlers and longliners)	6444	6483	5382	5890	5870	6014	76
Mauritanian trawlers	453	140	116			236	3
Other Nationalities Trawlers (target hake)	346	73	635	472	25	310	4
Other Trawlers (by-catch)	1893	1309	1685	1006	817	1342	17

The estimated stock biomass (B_{cur}) for the last year of data was of 71 967 t, achieving a Sustainable Yield or surplus of 11 829 t of black hake (CSY) (Table 2.X). If we consider that the Mauritanian fleet was fishing black hake (nowadays, we know that this fleet is not fishing) the surplus available would be of 11 593 t, after subtracting the Mauritanian catch (236 t). Consequently, the Spanish fleet (and the most relevant one), was fishing less (6014 t) than the total surplus estimated for that moment. Considering together the catch of the non-Mauritanian vessels together (i.e., EU [Spanish] vessels and non-EU fleets ["Other nationalities" and "Other trawlers"]), the obtained catch (7666 t) is still much lower than the estimated surplus. If the fishery continues their expansion towards reaching the MSY, the surplus production will then be reduced to around 9190 t (once the Mauritanian catch has been subtracted), but always higher than the mean catch of the non-Mauritanian fleets. We must remind that currently there are only Spanish trawlers targeting this resource, also fished as by-catch of other fleets.

Table 2.X. Parameters of *Merluccius* spp. (*M. polli* and *M. senegalensis*) production in Mauritanian waters, as estimated by the model and used as indicators of the surplus production. Differences between these indicators and the Spanish fleet' catch from 2004 to 2008 (Mau. Average Catch).

Parameters (*Merluccius* spp.)	Value (t)
CSY	11829
MSY	9429
Mauritanian Average Catch (2004-2008)	236
CSY – Mau. Average Catch	11593
MSY – Mau. Average Catch	9193

CSY= Current Sustainable Yield
MSY= Maximum Sustainable Yield
Mau. Average Catch = Average catch values by the Mauritania Fleet over the period 2004-2008.
CSY - (Mau. Mean Catch) = Surplus at the current year (last year of the assessment).
MSY- (Mau. Mean Catch) = Surplus in an equilibrium situation (MSY level)

Conclusion: We can consider that the EU fleet is currently fishing the surplus of *Merluccius* spp. resource. Furthermore, if the black hake resource continues to be only exploited by EU (Spanish) fleets (and not by Mauritanian and non-EU trawl fleets), it is probable that the surplus would be even higher.

2.3. GUINEA-BISSAUAN STOCKS

2.3.1. Hakes

Merluccius polli. **Guinea-Bissauan stock**

The stock status of this species has never been assessed in waters off Guinea-Bissau, where the diverse fleets (mainly European) are fishing Benguela hake as by-catch for several fleets. The by-catch of this species is certainly underestimated, as it is not always officially recorded, and there must also be non-controlled illegal fishing and discards. Table 2.XI shows the by-catch of *M. polli* made by different fleets.

Table 2.XI. Catch (t) of *Merluccius polli* in Guinea-Bissau over the period 2007-2009, with average values and percentages by fleet.

Fleet\Year	2007	2008	2009	Average	%
EU cephalopod freezer	1221	1254	44	840	97
EU shrimp freezer	15	5	0.3	7	1
Chinese fleet	0	0	1.2	0,40	0.05
Other Nationalities	0	47	10	19	2

The catch of EU cephalopod freezer trawlers (mainly Spanish) achieved in recent years (from 2007 to 2009) a catch level ranging between 44 and 1254 t, and was the fleet fishing the 97% of the total reported catch of this species. In 2009 and 2010 (the last year is not presented in the table) this catch decreased to only 44 and 45 t, respectively. The cephalopod freezer trawlers fish for Benguela hake when cephalopods' yields decrease.

Conclusion: We cannot estimate if the EU is presently fishing the surplus of these stocks due to the lack of information.

2.3.2. Other Demersal Finfish

Pagellus **spp. - Guinea-Bissauan stock**

The catch of this sea bream is poorly recorded in the data available for recent years. Thus, we do not have any fishing data about the species of the genus *Pagellus*.

Conclusion: We cannot estimate if the EU is presently fishing the surplus of these stocks due to the lack of information.

Solea spp. - Guinea-Bissauan stock

As already explained (see section 1.3), we think that the species marketed as "soles" in the fishery statistics are not really *Solea* spp. but other Pleuronectiformes. Due to this uncertainty and because the stock status of this genus has never been assessed, we can only present the catch figures of the whole fleet for this very appreciated flatfish genus (Table 2.XII).

Table 2.XII. Catch (t) of Pleuronectiformes over the period 2007-2009, with average values and percentages by fleet.

Fleet\Year	2007	2008	2009	Average	%
EU cephalopod freezer	910	431	423	588	39
EU shrimp freezer	108	90,2	202	133	9
EU finfish	1,3	0	49,7	17	1
Chinese fleet	135	582	576	431	28
Other Nationalities	142	149	767	353	23

These data show that "soles" are mostly fished as by-catch of the EU cephalopod freezer trawlers fleet, but also quite represented in the catch of the Chinese and other nationalities' fleets. In Guinea-Bissau, the fishing licence for fish is rarely used.

Conclusion: We cannot estimate if the EU is presently fishing the surplus of these stocks due to the lack of information.

3. EU DEMERSAL FLEET CATCH OR FISHING EFFORT, CORRESPONDING TO RESOURCE SURPLUSES AND, WHEN POSSIBLE, SHORT AND MEDIUM TERM FUTURE YIELDS AND STOCK ABUNDANCE PROJECTIONS.

This section compares the catch levels of the EU demersal fleets (targeting hake and other fish [finfish and elasmobranchs]) currently operating in waters off Morocco, Mauritania and Guinea-Bissau with the previously estimated surpluses of the different resources assessed in the FAO/CECAF Working Groups (see section 2). Furthermore, projections of both catch and abundance are presented for all the assessed stocks. These projections have been run through the MS Excel workbook created by Barros (2007), to enter the model parameters estimated for the stock, historical data available for the stock and the fishery, and for defining the conditions for the projections.

These short-medium projections are realised for a period of 5 years, and they cannot be used to simulate changes based on technical measures, but only those based on fishing effort, either assuming a reduction or a "status quo" situation (in which the effort is kept at the same level than in the current last year of the assessment).

When the only available and reliable data for a fishery are catch and effort (or catch and abundance indices) time series, we can only assess the management measures based on input or output control. This is the case of most of the hake and demersal fish stocks (finfish and elasmobranchs) analysed here.

3.1. MOROCCAN STOCKS

3.1.1. Hakes

Merluccius merluccius. Moroccan stock

As explained in sections 1.1.1 and 2.1.1, the last assessment of European hake stock carried out in the 2010 FAO/CECAF Working Group (FAO, 2010) showed that this species is heavily-overexploited in Moroccan waters, and there was not any surplus to be harvested by non-Moroccan fleets (EU or non-EU foreign fleets). Table 3.I presents the mean catch of the Moroccan fleets from 2004 to 2008. At the year of the assessment, this fleet was exceeding in 400% the estimated surplus of the resource and in 345% the surplus corresponding to the MSY (Table 3.I). In this case, the surplus parameters are CSY and MSY values, because the Moroccan coastal fleet is the only one exploiting the resource in the area.

Table 3.I. Percentage of catch for the Moroccan fleet, corresponding to the surplus of *Merluccius merluccius* in Moroccan waters.

Parameters (*Merluccius merluccius*)	Value (t)	% Surplus Moroccan fleet
CSY	1730	-400%
MSY	2007	-345%

CSY= Current Sustainable Yield = Surplus at the current year (last year of the assessment)
MSY= Maximum Sustainable Yield = Surplus in an equilibrium situation (MSY level)

The catch and abundance projections assuming the maintaining of the current exploitation pattern ("status quo") showed a drastic fall of the catch, the sustainable catch, and the relative abundance. The trend was similar even if a total allowable catch (TAC) was implemented (to reduce the catch levels). Different trials were attempted using different fishing effort levels, and the catch projection corresponding to a diminution of 40% of the fishing effort was eventually the one driving to a reduction of the catch to a level very close to the MSY in 2009, and a following slight diminution until 2013. Unfortunately, these catch levels will be even above those corresponding to the precautionary level $U_{0.1}$ (Figure 3.1).

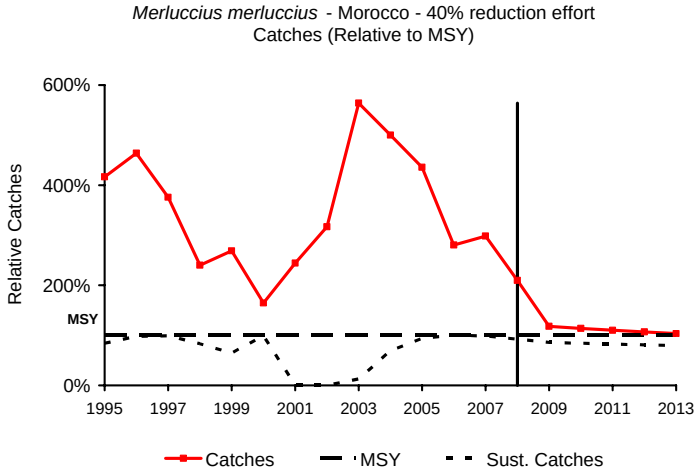

Figure 3.1. Short-medium term catch projections for *Merluccius merluccius* in Morocco, diminishing the current exploitation pattern effort (40%).

In spite of this improvement of the sustainable catch, the abundance projections with the same effort diminution (40%) show that the relative abundance will always be well below the relative abundance index corresponding to the MSY and also below the precautionary level $U_{0.1}$ (Figure 3.2).

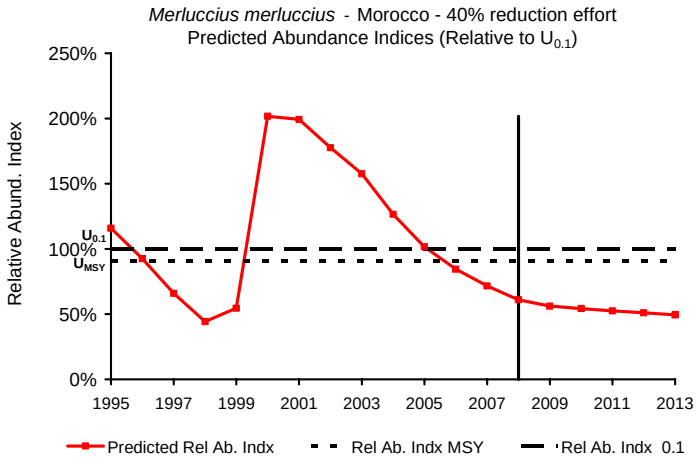

Figure 3.2. Short-medium term abundance predictions of *Merluccius merluccius* in Morocco, diminishing the current exploitation pattern effort (40%).

Even if there is not any European fleet targeting *M. merluccius* in Moroccan waters since 1999 (end of the fishing agreement), and despite no surplus is available for non-Moroccan fleets, we present the results to highlight the dramatic state of over-exploitation of the European hake populations. We must also remind that *M. merluccius* is targeted by the Moroccan coastal fleet, but that the directed fishing by join ventures longliners and the by-catch (both marketed and discarded) data are totally unknown.

***Merluccius senegalensis* and *Merluccius polli.* Moroccan stock**

The 2006 FAO/CECAF Working Group (FAO, 2006a), whose results were previously presented (see section 1.1.1) did not carry out any projection for the Black hake stock. We think that it is not useful to comment here a surplus available for the Spanish fleet that was estimated more than 10 years ago (1999 as the last year of data), when the Spanish fleet was the only one targeting black hake in Moroccan fishing grounds.

Since 2003, the Moroccan coastal fleet is exploiting these species, and its catch represented 70% of the total reported catch in the last two years of the series. (Table 2.III, Section 2.1.1). Thus, the 100% of the surplus available in 1999 to the Spanish fleet will now be somewhat reduced. Unfortunately, the Moroccan black hake stock has not been recently assessed using the latest available data of the fishery, which prevents any estimation of the EU catch level corresponding to the surplus.

In spite of the lack of a more recent assessment taking into account all these data, and bearing in mind the low fishing effort currently exerted over black hake stock (there are no fleet targeting black hake, which are only fished as by-catch by the Moroccan coastal fleet), we could think that the black hake stock is not currently over-exploited. After subtracting the Moroccan catch, there must be an exploitable surplus, even if it cannot be assessed on the basis of currently available data.

3.1.2. Other Demersal Finfish

In this group, the only species analysed is *P. acarne*, since the assessments attempted with other sea bream species did not give good results (see section 1).

***Pagellus acarne.* Moroccan stock**

The *P. acarne* average catch recorded for all fleets fishing this species are shown in Table 2.VI (Section 2.1.2). It clearly shows the negligible incidence of the artisanal Spanish vessels over this resource.

The surplus estimated based on the stock assessment parameters, showed that there was no surplus at the level of current stock biomass produced (-539 t) (in the last year considered, 2008). So, despite its low incidence over the resource, there was no surplus to be harvested by the Spanish artisanal fleet, because the Moroccan fleet had already harvested the 128% of the sustainable yield in that year (2008). This surplus (or sustainable yield) change with the stock biomass level, and its maximum value is the MSY if the current biomass stock (in the parameters model was 4582 t) is the same as the biomass that produce the MSY (13 027 t). In an equilibrium situation, the level of Spanish catch would only account for 0.15% of the *P. acarne* surplus (not exploited by the Moroccan fleets) at the MSY level (863 t) (Table 3.II).

Table 3.II. Catch percentage of the Spanish artisanal fleet, corresponding to the surplus of *Pagellus acarne* in Moroccan waters.

Parameters (*Pagellus acarne*)	**Value (t)**	**% Surplus Spanish fleet**
CSY - (Mor. Mean Catch)	-539	0.24%
MSY- (Mor. Mean Catch)	863	0.15%

CSY= Current Sustainable Yield

MSY= Maximum Sustainable Yield

Mor= Mean Catch = Average catch values by the Moroccan Fleet over the period 2004-2008

CSY - (Mor. Mean Catch) = Surplus at the current year (last year of the assessment)

MSY- (Mor. Mean Catch) = Surplus in an equilibrium situation (MSY level)

Short-medium term projections have been made, based on the results of the last assessment and diminishing in 10% the fishing effort of the last assessed year. The catch projection indicates a stabilization of the catch during the 5 years of prediction at sustainable and MSY levels (Figure 3.3).

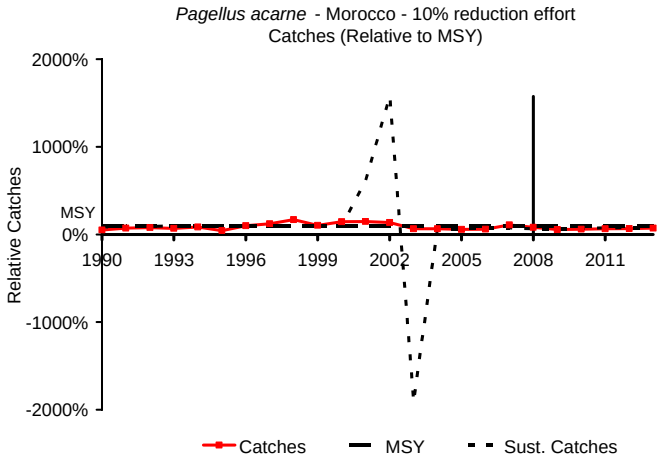

Figure 3.3. Short-medium term catch projections for *Pagellus acarne* in Morocco, diminishing the current exploitation pattern effort (10%).

The projected abundance index indicated a slight biomass increase after 2009 with a subsequent stabilization, but at levels well below the B_{MSY} and the precautionary level $U_{0.1}$ (Figure 3.4).

However, as mentioned in previous sections, parameters used as input data for the projections corresponded to the last assessment, which showed a quiet bad fit among the predicted and the observed abundances indices. Therefore, these projections should not be considered, due to its possible unreliability.

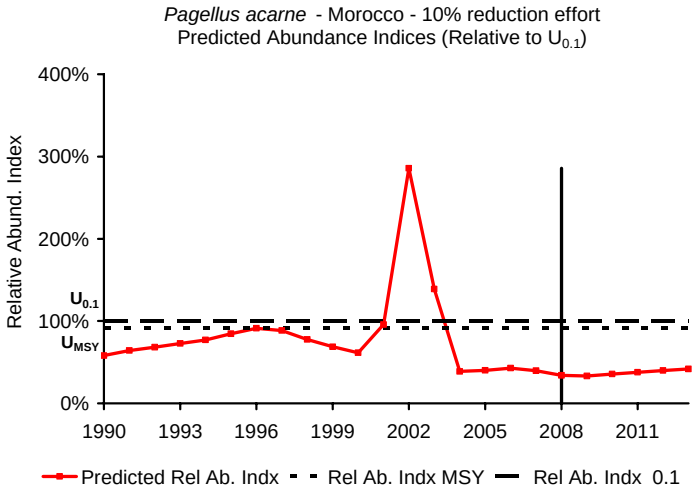

Figure 3.4. Short-medium term abundance projections for *Pagellus acarne* in Morocco, diminishing the current exploitation pattern effort (10%).

3.2. MAURITANIAN STOCKS

3.2.1. Hakes

Merluccius senegalensis and *Merluccius polli.* Mauritanian stock

The Spanish catch of black hakes over the period 2004-2008 averaged 6014 t (Table 2.IX., Section 2.2.1) accounts for 52% of the surplus yielded in the last year of the assessment (Table 3.III). Other fleets are fishing another 14% of this surplus, which means that all the foreign fleets (EU and non-EU) are exploiting 66% of the estimated surplus, leaving unexploited 34% of the surplus produced by the current stock biomass corresponding to 2008. In an equilibrium situation, the Spanish catch would be accounting for the 65% of the surplus production (at the MSY level).

Table 3.III. Catch percentage of the foreign fleets (EU [Spanish trawlers] and non-EU) corresponding to the surplus of *Merluccius* spp. in Mauritania.

Parameters (*Merluccius spp*)	**Value (t)**	**% Surplus EU fleet**	**% Surplus Other foreign fleets**
CSY - (Mau. Mean Catch)	11593	52%	14%
MSY- (Mau. Mean Catch)	9193	65%	18%

CSY= Current Sustainable Yield

MSY= Maximum Sustainable Yield

Mau. Mean Catch = Average catch values by the Mauritanian Fleet over the period 2004-2008

CSY - (Mau. Mean Catch) = Surplus at the current year (last year of the assessment)

MSY- (Mau. Mean Catch) = Surplus in an equilibrium situation (MSY level)

A short-medium term projection was made considering the maintaining of the current pattern of exploitation ("status quo" situation), since the last assessment of the resource (FAO, 2010) evidenced the good status of this stock. Figure 3.5 shows a minor catch increase from 2009 to its stabilization in 2012 and 2013, but with values slightly below the sustainable catch.

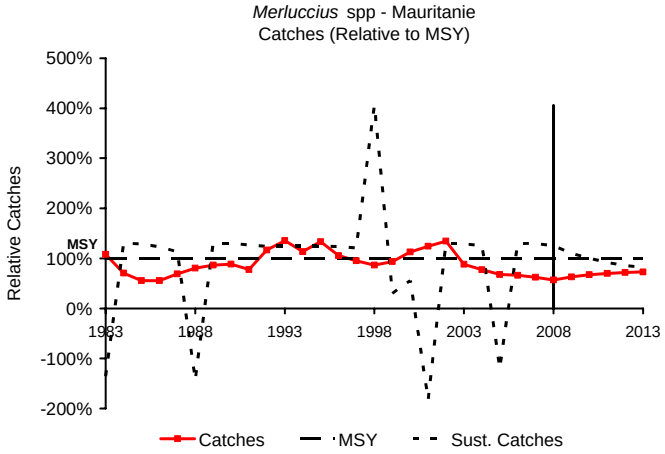

Figure 3.5. Short-medium term catch projections of *Merluccius* spp. in Mauritania, maintaining the current exploitation pattern ("status quo").

Over the five years of the abundance projection, the biomass will increase well above the U_{MSY} and the precautionary level $U_{0.1}$.(Figure 3.6). These results are consistent with the exploitation status of the stock in recent years.

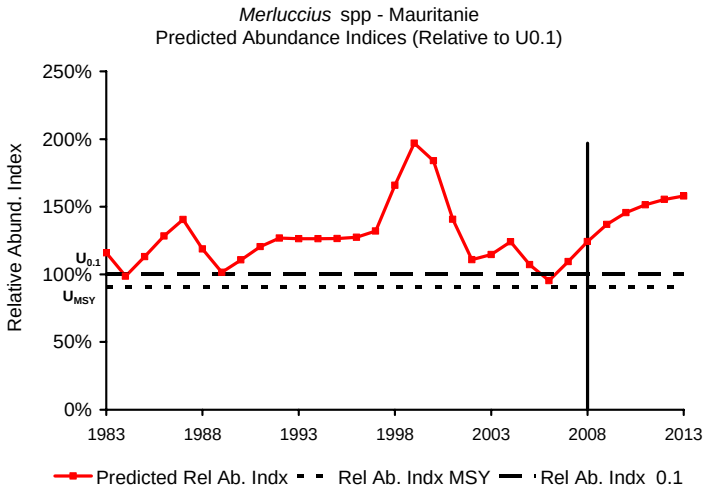

Figure 3.6. Short-medium term abundance projections of *Merluccius* spp. in Mauritania, maintaining the current exploitation pattern ("status quo").

3.3. GUINEA-BISSAUAN STOCKS

3.3.1. Hakes

Merluccius polli. Guinea-Bissauan stock

This resource has not been assessed. Therefore, we are not able to calculate the EU catch level corresponding to the surplus. The EU cephalopod freezer trawlers' fleet is the main one catching this species (97% of the total fleet catch). The cephalopod freezer trawlers fish large quantities of Benguela hake as by-catch (averaging 1238 t from 2007 to 2008), mostly when the yield of the targeted cephalopod resources decreases. Projections could not been made due to the absence of assessments.

3.3.2. Other Demersal Finfish

Pagellus spp. Guinea-Bissauan stock

The catch of this resource is unknown. We only have few statistical data of some sea bream species, such as Sparidae (mainly *Dentex*). It is worth reminding that the catch values of the EU cephalopod freezer trawlers are quite low for the species of the genus *Dentex* spp (161 t in 2007). For the Chinese fleet, the catch of *Dentex* spp. only accounted for 3%-5% of the total catch. This stock has not been assessed and therefore, the EU catch level corresponding to the surplus could not be estimated. Short-medium term projections are not available due to the lack of assessments.

Solea spp. Guinea-Bissauan stock

The catch of these flatfishes is not officially recorded. Thus, there are no available fishery data enabling the assessment of the state of this resource. Therefore, we can neither estimate the EU catch level of the surplus nor attempt any short-medium term projection. The greatest catch of flatfish is made by EU cephalopod fleets, averaging 588 t over the period 2007-2009 (Table 2.XII, Section 2.3.2).

Most of the estimations of the EU catch levels were made from the available industrial fishery information. It is worth remembering the uncertainty of the reported data from other foreign (non EU) fleets as well as the ignorance of the artisanal catch statistics, and the high estimated values of IUU fishing in Guinea-Bissau (MRAG, 2010). Therefore the EU catch levels in relation to other fleets may be greatly overestimated.

4. CLOSED SEASONS OR CLOSED AREAS WHICH COULD BE DEFINED FOR DEMERSAL FISH (HAKE AND OTHER FINFISH) FISHERIES

To define possible close seasons or close areas for demersal fish resources (hakes and other finfish) fisheries in waters off Morocco, Mauritania and Guinea-Bissau, basic knowledge is required, both of the biology of the species and the seasonal and spatial activity of the involved fleets.

For these reasons, two main aspects will be described for every fishery:

a) Available biological information on the species,

b) Information on seasonal and spatial distribution of the fleets operating in the area.

4.1. HAKE FISHERIES

Merluccius merluccius, M. senegalensis and *M. polli*

Off the North-West African coast, the areas of distribution of three hake species (*Merluccius merluccius*, *M. senegalensis* and *M. polli*) overlap. Detail descriptions of these species are given by Lloris *et al.*, 2003. Taxonomic determination of these species is based on the colour of the back and on internal characters (Inada, 1981). Sorting hakes' catch into species is difficult in practice, and even more for the two black hake species (*M. senegalensis* [Senegalese hake] and *M. polli* [Benguela hake]), whose morphological resemblance and overlapping occurrence at certain depths, mix both species in the catch of the diverse fleets harvesting them. Thus, the available commercial catch data of fishery statistics correspond to the fished amount of the two species, marketed as *Merluccius* spp. For this reason, the fishery statistics are given for the two species as a whole.

4.1.1. Biological information on the target species

The European hake (*M. merluccius*) reaches its southern distribution limit in Mauritanian waters (21º). South of Cape Cantin (33º N), the European hake mixes with Senegalese hake (*M. senegalensis*). The latter species occurs from 33º N to 10º N (Cape Roxo). South of 25º N, the Benguela hake (*M. polli*) spreads over the whole Guinean Gulf and reaches Angolan waters (18º 50' Sº.

Hakes have a wide bathymetrical distribution, stretching from 25 to 1000 m depth. Hake abundance increase with depth, depending on species and latitude. Average body size of hake increases with increasing depth in all three species (López-Abellán & Ariz Tellería, 1993). Larger individuals, which correspond to females, live in deeper waters, where also small-sized specimens can be found. *M. merluccius* is usually found between 70 and 370 m, but its depth limits extend from 30 to 1000 m. The Senegalese hake lives between 20 and 600 m depth and the Benguela Hake between 50 and 1000 m (Fernández *et al.*, in press).

MOROCCO

Spatial Distribution

No recent references have been found about new studies on the distribution of the three hake species in Moroccan waters. The latitudinal and bathymetric ranges have been established by the prospective surveys carried out onboard Spanish R/V Vizconde de Eza in 2004, 2005 and 2006. The survey areas covered the northern, central and southern zones of Moroccan waters. The prospected depths ranged from 500 and 2000 m (2004 and 2005 surveys), and from 200 and 2000 in Saharan waters (2006 survey). Thus, these campaigns did not prospect the shallower and more coastal strata for any of these species, and consequently did not bring relevant information about the abundance and the distribution of the hake species living in Moroccan waters. In addition, as the three surveys were carried out in the same season (November and December) and prospected different zones off the coast, they do no reflect any eventual seasonal variation of the species distribution.

In the survey prospecting the north area (36º-30º N), *M. merluccius* recorded maximum abundance values between 500 and 800 m in front of Agadir (in the southern sector of the survey), with average yield values of 5.2 kg/h. *M. senegalensis* was rarely fished south of 33º N.

In the survey prospecting the central area (31º-26º N), *M. merluccius* was evenly found, with maximum abundance values recorded between 600 and 700 m, and no records at depths greater than 800 m. The global yield was of 8 kg/h. At the survey depths, the European hake relative biomass was only 195 t. *M. senegalensis* was also found in the whole survey area, mostly between 500 and slightly more than 800 m. The maximum abundance values were recorded from 600 to 700 m, and a relative biomass at the prospected depths of 92 t. The populations of both hake species were composed of adults, and no recruitment areas were identified in the survey zone.

European hake was the predominant species both in the north and central survey areas.

In the survey prospecting the south area (26º-21º N) were fished the three hake species. The abundance of M. merluccius decreased southwards, whilst the abundances of *M. senegalensis* and *M. polli* increased. *M. polli* was here the predominant species, achieving the highest yields (more than 30 kg/h). *M. merluccius* was found between 230 and 700 m; *M. senegalensis* between 336 and 990 m; and *M. polli* between 335 and 950 m. The three hake species were latitudinally overlapping between 25° N and 20° N, being the only known case of three hake species sharing the same geographical area (Fernández-Peralta *et al.*, in press).

Reproduction/recruitment areas and seasons

European hake lay eggs all year round, with two peaks identified in summer and in winter (Maurin, 1954; Goñi and Cervantes, 1986; Ramos *et al.*, 1996), and spawning depths between 100 and 150 m. Consequently, the recruitment occurs all year round but records maximum values in spring-summer (Meiners, 2007a; b). The prospective surveys only identified European hake recruits concentrated at depths between 900 and 1000 m in the northern survey zone, and between 300 and 500 m in the southern zone. These concentration areas could be spawning areas, but we must take into account the high bathymetric bias of these data.

The life cycle has not been studied for black hake species in Moroccan waters, but we know that the two species of black hake have a winter spawning peak, even if it has not been recently confirmed. For these two species, the available studies about distribution and spawning zones, sizes at first maturity and sex-ratio are dated, and there are hardly any recent researches focussing on the biology of these species in Moroccan waters.

Abundance fluctuations

A recent study on how the climatic variability influences the abundance of the European hake in Moroccan waters showed that its abundance was positively correlated with favourable oceanographic conditions and productive regimes associated with positive NAO (North Atlantic Oscillation) index values (Meiners, 2007). Even if the recruitment of the European hake has a weak seasonal component (because it shows continuous spawning throughout the year), the NAO affects its dynamics by widening/narrowing the recruitment window: a positive NAO index favours the successful recruitment of several cohorts per year, whilst a negative index weakens the successful cohorts and reduce their number (Meiners, 2007a).

The period from 2000 to 2009 was dominated by negative values of the NAO index (i.e. 2001, 2002, 2005, 2006, 2008, and 2009) in the area, a fact probably limiting the optimal recruitment windows for the European hake populations, whose abundance indices (Moroccan surveys and fishery CPUEs) were shown to be declining. Moreover, a drop was also observed in the same data series of abundances in 1998, after a period of several years of NAO negative indices' predominance..

It has also been proved that the black hake abundance (considered as a single stock in the North West African coast) was higher when the NAO proxy was negative (Meiners *et al.*, 2010). We can therefore assume that the oceanographic conditions derived from the climatic regime play a major role in the fluctuating abundances of the European hake Moroccan populations.

MAURITANIA

Spatial Distribution

The catches of European hake are scarce in Mauritanian waters, while those of black hake support this fishery.

The most recent studies on black hake latitudinal and bathymetrical distribution have mostly been based on data from scientific observers onboard commercial vessels in the area. In Mauritanian waters, *M. senegalensis* is a shallow species, inhabiting the continental shelf and upper slope up to approximately 600 m, whereas *M. polli* dwell in a much wider depth range (between 100 and 1000 m), thus being the only species beyond 600 m. Since trawl fleets generally operate at in deep fishing grounds (400 to 800 m), their catch is mostly composed of the species having the deepest habitat, *M. polli* (accounting for 90%-95% of the total catch). On the contrary, as the, longliners fish in shallower grounds (up to 500 m), their catch has a higher proportion of *M. senegalensis*, accounting for 67 % of the total catch (Fernández *et al.*, 2006 a) (Fig 4.1).

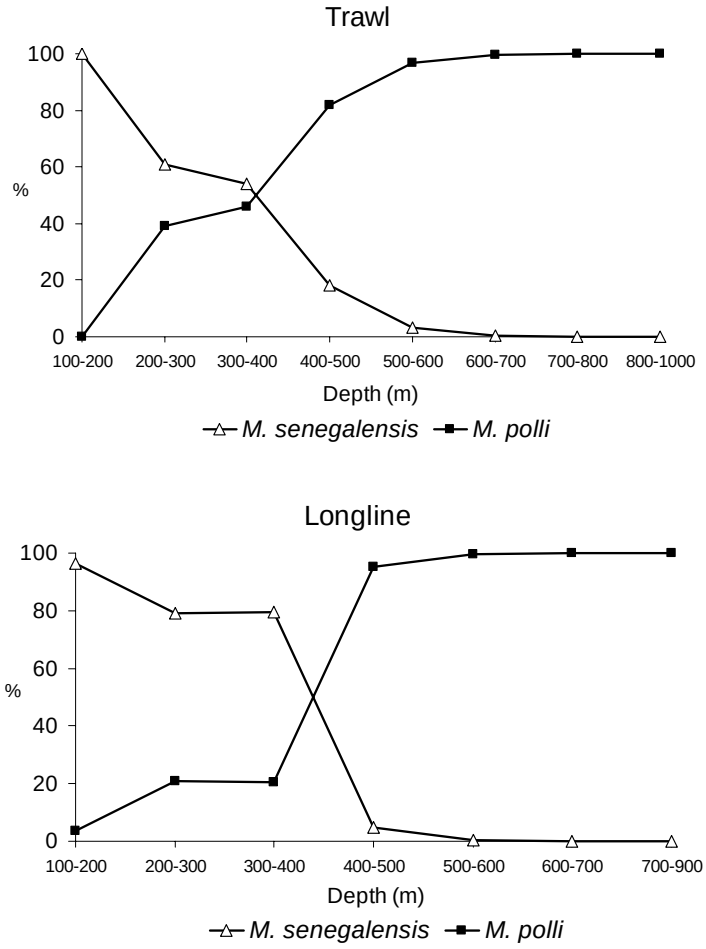

Figure 4.1. Bathymetric distribution of black hake species (*Merluccius polli* and *M. senegalensis*) in Mauritanian waters. Data from trawl and longline fleets from 2003 to 2004.

Data of previous surveys showed the existence of seasonal latitudinal migrations of *M. senegalensis* and *M. polli*. During the warm season (august-october), *M. senegalensis* migrates to the North, avoiding hot/warm waters and increases its abundance in Saharan waters and south of Cape Blanc. During the hydrologic cold season (January-may), the arrival of cold northern waters triggers the southwards migration *M. senegalensis* migrates southwards, increasing its yields in the Mauritanian southern fishing grounds and in the north of Senegalese waters. A similar migratory pattern has been observed for *M. polli* (Wysokinski, 1986; FAO, 1986 a; b). Bathymetric migrations are also frequent in these species, which meet at greater depths when the continental shelf water warms up, being this fact more evident in the shallower species. This hydrological pattern characterizes the area and determines the distribution and abundance patterns observed along the year (Fernández *et al.,* 2008).

Four demersal research surveys have been carried out in waters off Mauritania, between 2007 and 2010, following a random stratified sampling scheme. Surveys from 2008 to 2010 sampled a wide depth range from 100 to 2000 m (six strata) while the 2007 survey only fished deeper than 400 m (four strata). Even for coincident depth ranges (2008 to 2010 surveys), the haul distribution differed

between years. In 2008, 62% of the hauls were performed between 100 and 400 m (19 040 nm^2) and 38% in a wider and deeper area from 400 to 2000 m (22 127 nm^2). The same year, a conspicuous recruitment occurred in the shallowest depths explored, obviously strengthened by the sampling scheme. Both the different depth ranges sampled in 2007 and the haul allocation divergences from 2008 to 2010 make difficult to perform a proper analysis of the whole population.

Figure 4.2 shows the abundances (No. individuals/hour) and yields (kg/hour) estimated for both in the 4 research surveys carried out in the area.

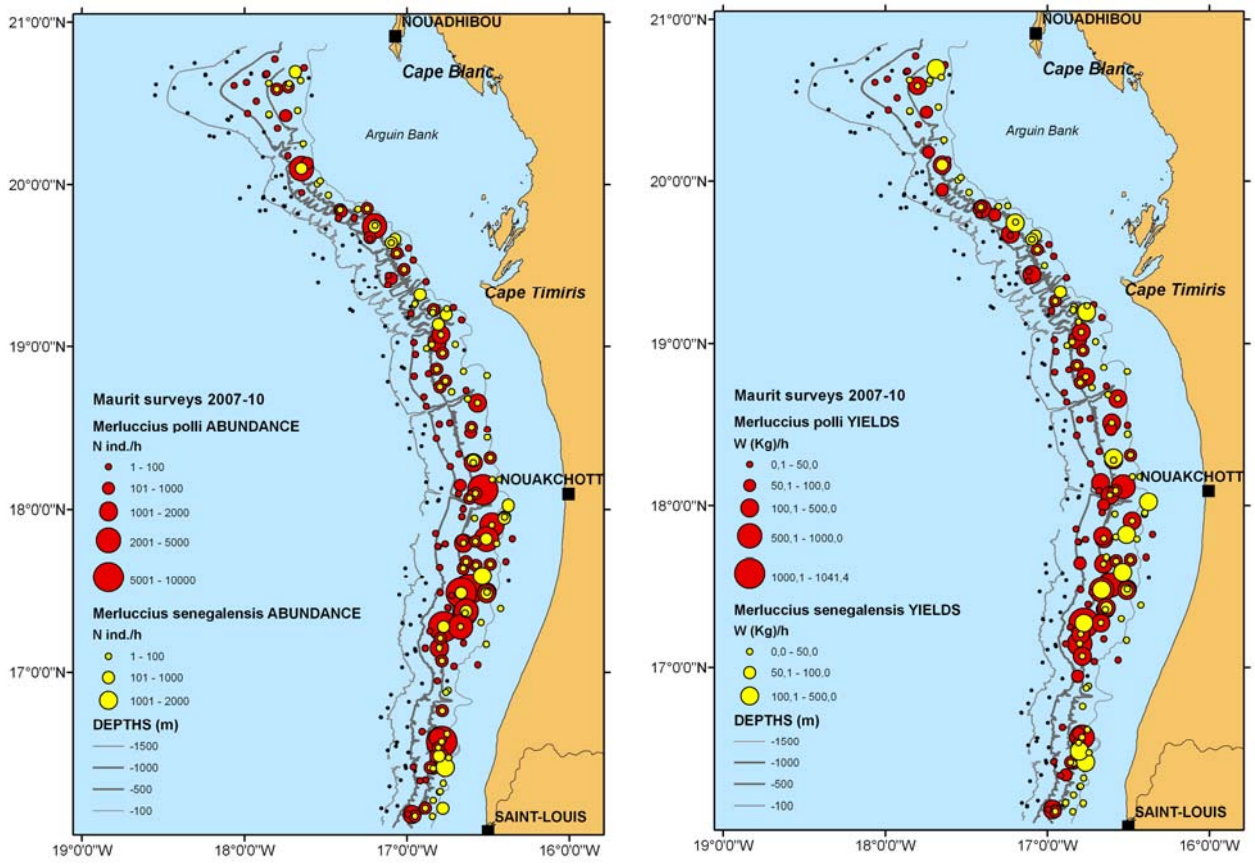

Figure 4.2 Spatial distribution of abundance (left) and yields (right) of *Merluccius polli* and *M. senegalensis* in Mauritanian waters. Spanish research surveys (4) carried out between 2007 and 2010 (Spanish R/V *Vizconde de Eza*).

Black hakes are distributed along the whole Mauritanian coastline, with the highest abundances and yields being recorded south of 18º 30' N. Although north of Cape Timiris some spotted high densities come into view for both species, wide-ranging abundances are lower. Some of these sites, mainly from 300 to 500 m, correspond to recruitment aggregations. As these surveys were always carried out in autumn, the recorded abundances and yields could not evidence any seasonal variation in the species distribution.

Concerning the 4 research surveys, *M. senegalensis* was a much less abundant species (averaging 14% of the total hake catch), reaching a maximum depth of 660 m. *M. polli* was thus the prevailing species within the hake catch, appearing up to 100 m depth. We must remind here that the samples taken in shallow grounds (up to 100 m) were very scarce and therefore, a significant fraction of the *M. senegalensis* population remained under represented.

Reproduction/recruitment areas and seasons

In Mauritania, both species spawn from September to March (Sobrino *et al.*, 1990; Fernández-Peralta *et al.,* in press). Their sexual activity starts in September and the spawning intensifies from November to February. There is probably a certain overlapping in the spawning periods of both species, resulting in an enlarged episode when considering them as a single stock.

Reproduction areas are mainly located in central (18º 42' N and 18º 02' N) and southern (16º 50' N and 16º 30' N) zones, where the reproductive adults (spawners) gather around large canyons. Also here, *M. polli* reaches greater depths. Probably, the Benguela hake occupies a great number of untrawlable areas than Senegalese hake does, since the huge sampling during the full spawning season showed that spawning *M. senegalensis* females were much more frequent (13%) than those of *M. polli* (6%), having the deepest habitat.

Mature females of both species have been found from 300 to 500 m in the south zone, while spawning males were segregated at different depths, averaging 275-315 m and 550-560 m for *M. senegalensis* and *M. polli,* respectively, in all area. This bathymetric divergence between species clearly confirms the existence of a bathymetric segregation of the spawners and the existence of a deeper spawning ground for *M. polli* than for *M. senegalensis*. In fact, even if the two species share neighbouring reproductive areas and depths, they keep separate from each other while spawning (Fernández-Peralta, *et al.*, in press). These reproduction areas are extremely coincident with those described elsewhere (Maurin, 1954; García, 1982; Wysokinski, 1986) and most likely extended to Senegalese waters (García, 1982; Ramos *et al.*, 1991; Ramos y Fernández, 1995; Lloris *et al.*, 2003).

The recruitment areas (concentrations of small [<30 cm] individuals) identified during the above mentioned research surveys were observed for both species, and were in agreement with the described spawning areas and depths. We must mention the strong recruitment detected during the 2008 survey, when the 100-400 m depth range was largely sampled. *M. polli* recruits were evenly distributed south of Cape Timiris and between 100-300 m depth, and occasionally up to 500 m. *M. senegalensis* recruits were much less abundant and were caught approximately from slightly less than 100 m (in the few trawl that were less deep) to 500 m on the unusual occasion.

During the first research survey carried out in Mauritania (2007), the sampling was performed from 400 m, and only *M. polli* recruits were barely present in the catch (Figure 4.3).

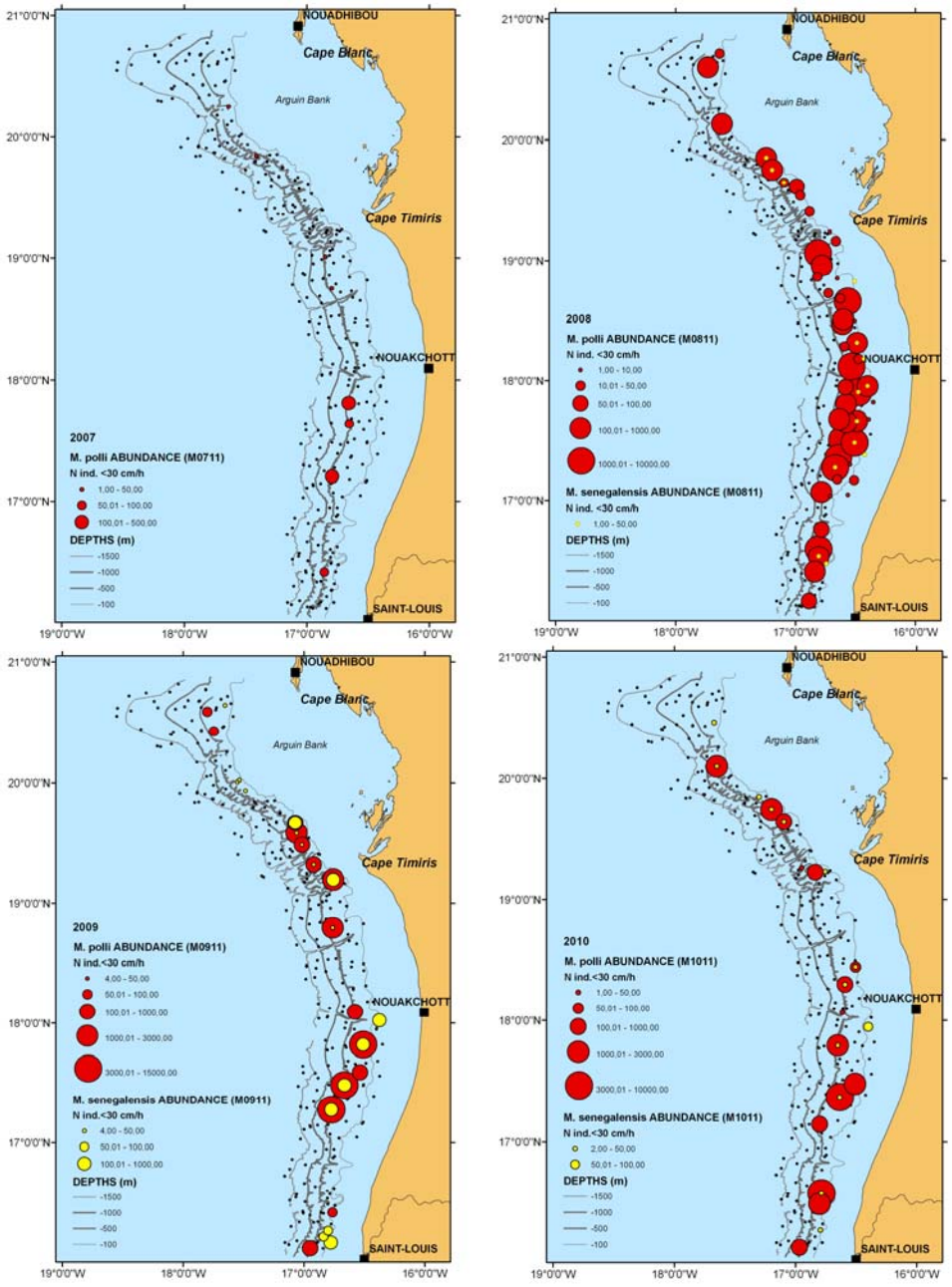

Figure 4.3. Spatial distribution of recruits (individuals<30cm TL) abundance (No ind/hour) of *Merluccius polli* and *M. senegalensis* in Mauritanian waters during the Spanish research surveys (4) carried out between 2007-2010 (Spanish R/V *Vizconde de Eza*).

The seasonal variation of the recruitment was analysed based on the available series of monthly percentages of *Merluccius* spp individuals smaller than 30 cm in the catch. These data are previous to the implementation in 1998 of a minimum legal landing size of of 30 cm (Ramos *et al.*, 1998). These percentages were always higher during the warm-cold transition season, between September and October, and from February to March. In spring-summer, we also observed high percentages of recruits, although less frequently.

In the 2007, 2008 and 2009 surveys, the sex-ratio (♂:♀) by size-class evidenced the predominance of *M. polli* females (1:1.7) for the individuals of more than 43 cm total length (TL) and of *M. senegalensis* females (1:1.5) for the individuals of more than 49 cm TL.. Also, the maximum sampled sizes (TL, cm) were higher for *M. senegalensis* (TL=82.9 cm for females and 67.7 cm for males) than for *M. polli* (TL=71.1 cm for females and 58.5 cm for males).

The higher proportion of females could be related to reproductive migrations, as described for these and other hakes (Doutre, 1960; Wysonkinski, 1986; Botha, 1986; Tingley *et al.*, 1995). Moreover, we think that males could be form concentrations in shallow waters (up to 100 m depth). The proportions of females recorded during the research surveys (with trawl gear) were similar to those obtained by commercial trawlers and much lower than the proportions of females fished during the experimental longline survey in the area (1:5.0 in *M. polli* and 1:3.6 inn *M. senegalensis*) carried out in 2003-04 (Fernández -Peralta, *et al.*, in press).

The most recent size-at-first-maturity estimates (L_{50}) from black hake females showed higher values for *M. polli* (TL=44 cm) than in *M. senegalensis* (TL=39 cm). For males, the L_{50} estimates were more imprecise and variable, given that males are less represented in the sample. Anyway the size-at-first-maturity values provisionally accepted were been estimated from the data of the commercial surveys carried out during the spawning season of 2003-2004: L_{50}=37 cm TL (*M. polli)* and L_{50}=33.5 cm TL (*M. senegalensis)* have been established from commercial surveys performed during spawning season 2003-04 (Fernández-Peralta, *et al.,* in press).

Tables 4.I and 4.II show the previous estimations of the size at first maturity calculated in the area for *M. polli* and *M. senegalensis.* The discrepancies with certain studies carried out by means of macroscopic methods suggest that maturity estimations of L_{50} should be undertaken at the histological level, especially because hakes are species of indeterminate batch fecundity (Fernández-Peralta*, et al., in press*).

Table 4.I. Length at first maturity (L_{50}) of *M. polli* estimated along the North West African coast.

Area	L_{50}	N	Reference
Mauritania	♂: 34.3 cm ♀: 39.2 cm T: 37.0 cm	2007 5271 7278	Fernández *et al.*, 2006 b; FAO, 2007
Senegal	♂: 20-24 cm ♀: 35-39 cm	unknown	Caverivière *et al.*, 1986
Senegal	♂: 25.2 cm ♀: 27.5 cm	643 614	López-Abellán y Ariz-Tellería, 1993
Senegal	♂: 30.2 cm ♀: 38.1 cm T: 33.6 cm	430 554 984	Fernández-Peralta, 2009
Toute la zone	♂: 27 cm ♀: 34 cm	unknown	ATLANTNIRO, 1978; FAO, 1978

Furthermore, the required data for assessment purposes is a unique L_{50} (both sexes combined) for each species. Although this kind of estimations are rare, a L_{50} value of 39 cm was calculated for *Merluccius* spp.(both sexes combined) on the basis of the data collected in some commercial trips (2003) (Fernández-Peralta, comm. pers.).

Table 4.II. Length at first maturity (L_{50}) of ***M. senegalensis*** estimated along the North West African coast

Area	L_{50}/A_{50}	N	Reference
Marruecos	T: 24 cm	170	Maurin, 1954
Marruecos	T: 2.9 ans	unknown	Bourdine, 1986
Mauritania	♂: 26.42 ♀: 29.69	182 206	Sobrino *et al.*, 1990
Mauritania	♂: 33.0 cm ♀: 39.2 cm T: 35.4 cm	458 1497 1955	Fernández *et al.*, 2006 b; FAO, 2007
23º30'-15º N	♂: 4 ans ♀: 5 ans	798	Wysokinski, 1986
Mauritania y Senegal	T: 38 cm	614	Doutre, 1960
Senegal	♂: 25-29 cm ♀: 30-34 cm	unknown	Caverivière *et al.*, 1986
Senegal	♂: 30 cm ♀: 40 cm	unknown	Postel, 1955
Toute la zone	♂: 28-30 cm ♀: 32-36 cm	unknown	ATLANTNIRO, 1978; FAO, 1978

The growth patterns and parameters are unknown for these species. Recent studies of NE Atlantic European hake have shown that the rate of somatic growth was two times higher than the one predicted by internationally agreed otolith ageing criteria. First results on black hake otolith macrostructure showed the existence of significant differences in the growth patterns of the two species, even if both of them belong to the same genus and cohabit in the same area. Therefore, the results obtained for one species cannot be extrapolated to another, and although they point towards a fast growth rate, microstructure studies are needed to corroborate the observed divergences in growth between the two black hake species in the area (Rey *et al.*, in press).

Abundance fluctuations

As previously said, black hake abundance is highly and negatively correlated with the NAO index. This climatic indicator explains about 40-50% of the CPUE series variation from 1960 to 2003, for both black hakes in the whole distribution area (Sahara, Mauritania and Senegal). (Meiners *et al.* 2007 c; 2010). In the last decade, this climate *proxy* showed a strong negative tendency, favoring an increase of the hake biomass stock.

GUINEA-BISSAU

Spatial Distribution

M. polli is the dominant hake in Guinea-Bissau, where *M. senegalensis* is much less abundant and is mainly present in the northern area catches. The trawl fleets have never been fishing for hake in this fishing ground, a fact greatly hindering the knowledge of its population and biology.

The main and most recent information for *M. polli* spatial distribution in Guinea-Bissauan fishing grounds comes from two research demersal trawl surveys carried on in 2002 and 2008 onboard R/V *Vizconde de Eza*. During both surveys, a random stratified sampling scheme was followed from less than 50 m to 800-1000 m depth.

Figure 4.4. shows the abundance and the number of *M. polli* individuals per haul, as estimated for both demersal trawl surveys, clearly evidencing the dramatical drop experienced by *M. polli* population in Guinea-Bissauan waters. The maximum abundance values were recorded in the 200-500 m depth stratum, mostly in 2002.

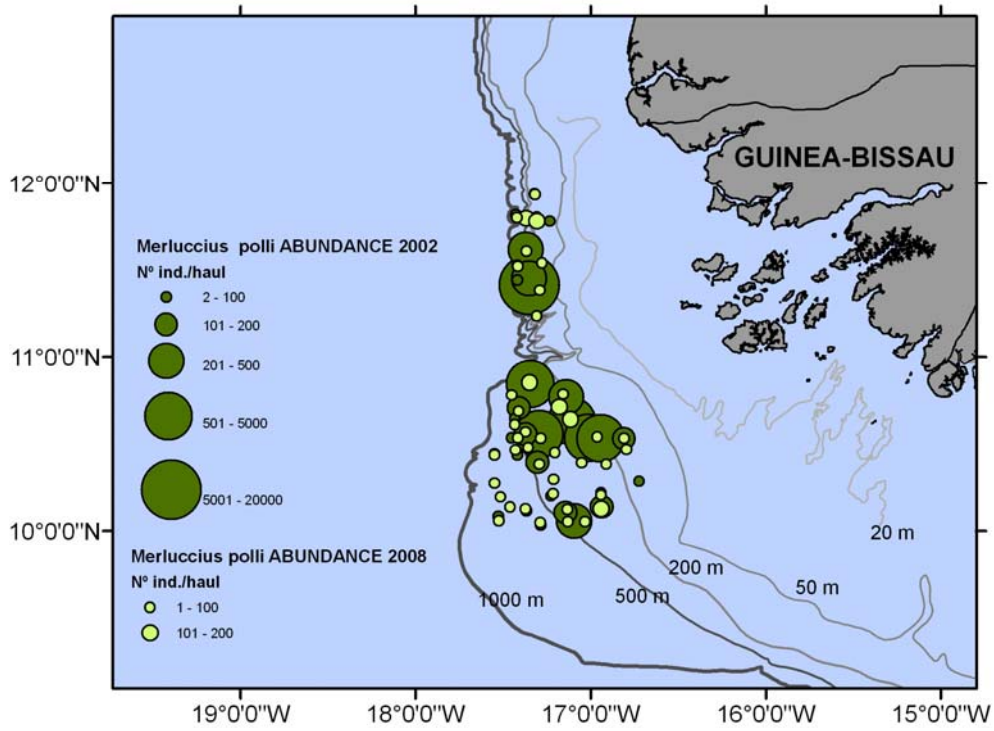

Figure 4.4. Spatial distribution of abundances (No ind./haul) of *Merluccius polli* in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

The estimated hake biomass registered a dramatic drop (of more than 10 times) in 2008 when compared with the 2002 estimation. In addition, this decrease took place in the 200-500 m depth range (Table 4.III).

Table 4.III. Estimated biomass (t) by depth strata and total area of *Merluccius polli* in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

Survey	50- 200 m	200 – 500 m	500 – 1000 m	Total area
BISSAU 0210	97	10209	327	10633
BISSAU 0810	37	652	214	903

M. polli population structure was similar in both research surveys, where prevailed the small-sized specimens. More than 70% of the catch was composed of hakes smaller than 30 cm TL, with modes around 20-30 cm and a maximum size of 57 cm TL (García-Isarch *et al*., 2009). Hake occurred frequently in a wide depth range, from 80 to 900 m, mainly concentrated between 200 and 500 m.

Reproduction/recruitment areas and seasons

No studies have been published on the reproductive features of *M. polli* in the area. In 2008, the research survey noticed a strikingly predominance of females (1:10), where it was roughly observed that 50% of females were sexually mature at 42 cm TL.

Abundance fluctuations

To date, the abundance fluctuations of *M. polli* have not been studied and are still unknown, even if we think that in these southern latitudes the NAO index influence must be less important.

4.1.2. Information on seasonal and spatial distribution of the fleets targeting hakes

MOROCCO

We have no information about the Moroccan fleets targeting the hake species (the only ones exploiting these resources since 1999), but presumably they are exerting a high fishing pressure on hakes.

However, between 2008 and June 2010, only one Spanish vessel was fishing for black hake under a fishing category provided for the new Agreement, which included 11 annual licences of this kind for UE trawlers. The catch and effort series (2008-2010) of this vessel are available, but we do not have any geo-referenced information enabling a spatial analysis of its activity. The scientific observer occasionally embarked onboard reported that this Spanish vessel performed mainly deep hauls, from 400 to 1000 m and discarded low quantities of hake. The same fishing strategy was observed when the vessel was operating in Mauritania, landing in some occasions even hakes of the small-sized commercial category.

Vessels operating under this license were abide by the seasonal closure in force for the cephalopod fleet (May-June and October-November), a fact that forced the Spanish vessel to switch into the Mauritanian fishing grounds during these months and also in December, when hake yields become higher. This fact is clearly shown by the fishing effort gaps along the year (Figure 4.5a). Figure 4.5b shows that the yields were remarkably high at the beginning of the fishing activity, in 2008,

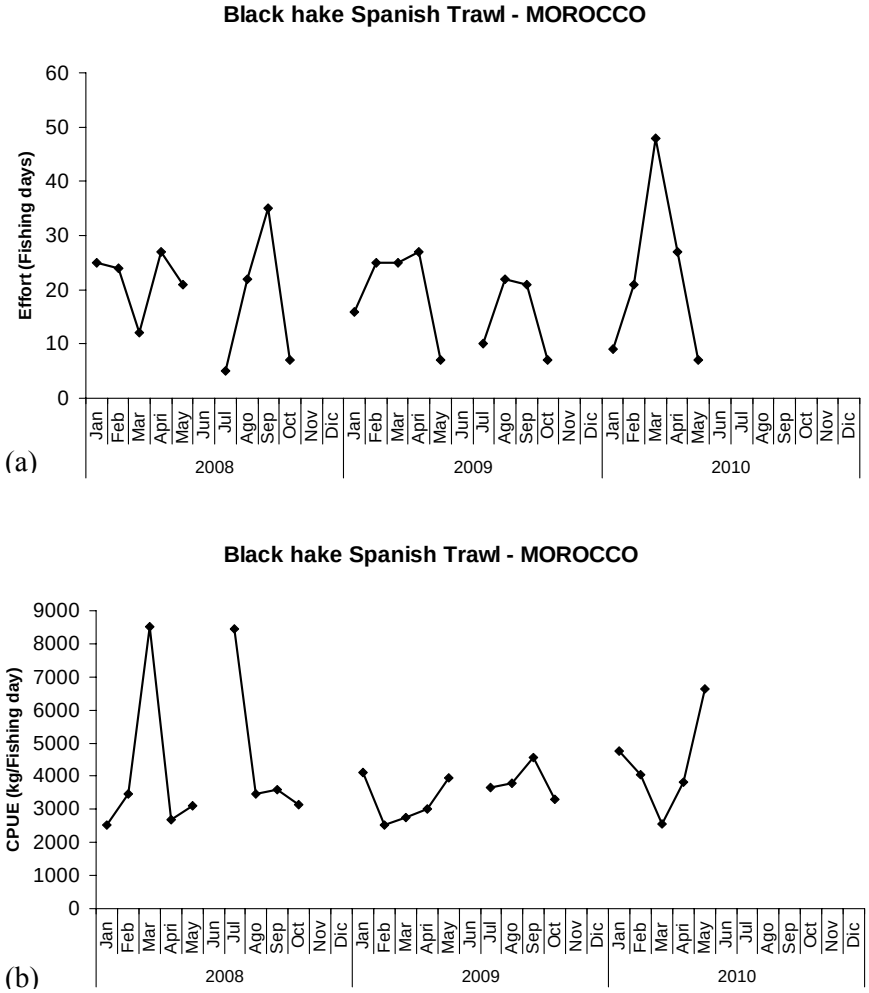

Figure 4.5 (a) Monthly effort (fishing days) of the Spanish black hake trawler operating in Morocco between January 2008 and June 2010. (b) Monthly CPUE (kg/fishing day) of *Merluccius* spp

MAURITANIA

Figure 4.6 presents the monthly evolution of the fishing effort and the CPUE of black hake Spanish trawl fleet in Mauritania, from 2008 to 2010. As shown in Figure 4.6a, the, number of vessels has been gradually decreasing: 8 in 2008, 7 in 2007, 6 in 2010, and only 2 units at the end of this year. The Spanish vessels have progressively abandoned Mauritanian fishing grounds not because of the low hake yields (Figure 4.6b), but due to the indiscriminately unlawful sanctions and arresting imposed on the Spanish wet-trawl fleet over these years (Iborra, 2010).

Mean yields for the whole period were over 3500 kg/fd, with a maximum of 3900 kg/fd in 2010. When compared with the historical yield data series, these values are the highest recorded since 2000, when the fishery was yielding more than 5000 kg/fd. The CPUE peaks observed from October to January, both in 2009 and 2010, are probably due to the southwards reproductive migration of hake, gathering spawning adults in central and southern sectors of Mauritania and north Senegal.

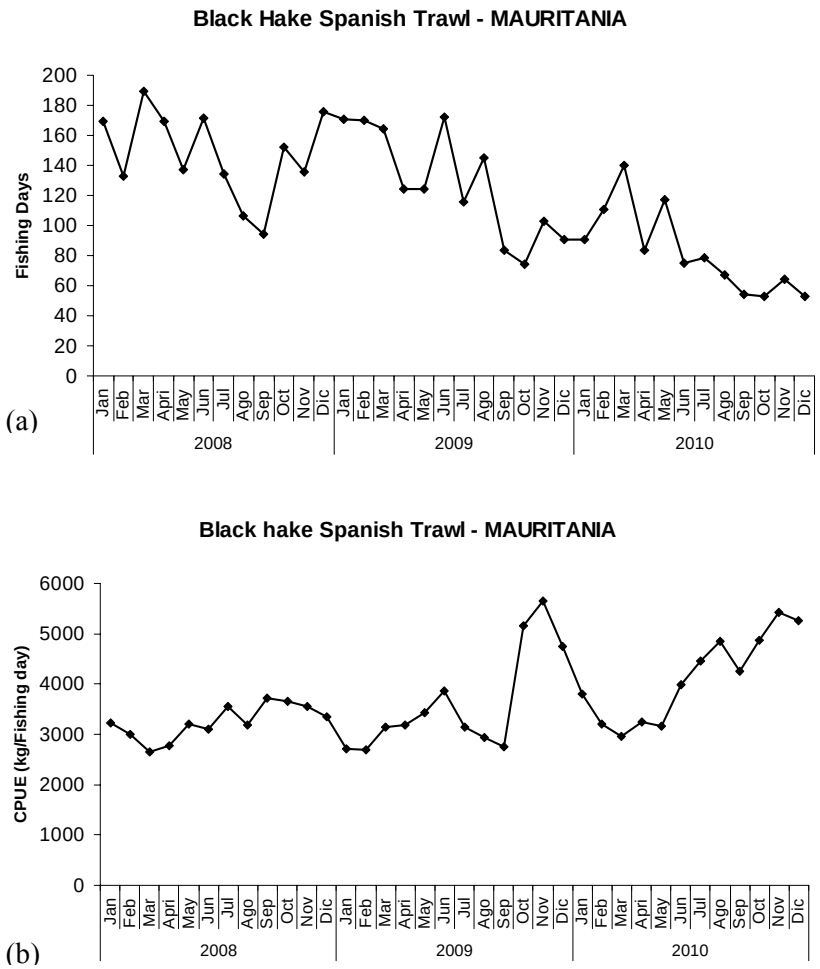

Figure 4.6 (a) Monthly effort (fishing days) of the Spanish black hake trawlers operating in Mauritania between 2008 and 2010 (b) Monthly CPUE (kg/fishing day) of *Merluccius* spp.

Around 80% of the Spanish black hake trawl fleet hauls are performed between 400 and 800 m depth. Figure 4.7 represents the hauls carried out in nine fishing trips of around seven days each one (mean fishing trip duration), as well as the obtained recruit (hakes<30cm TL) abundances (2009-10). As it can be seen, the hauls are mostly located beyond 500 m depth and along the whole study area, although prevailing in the central sector and, in December, in some south locations, following the hake latitudinal migrations. Deep fishing strategy avoids the presence of recruits in the catch that eventually should be discarded (under minimum legal size) and ensures a high catch of the largest hake commercial categories.

Once more, the recruits are located both in central and southern Mauritanian canyons, where the spawning areas have been recently described (Fernández-Peralta *et al.*, in press) and in shallower waters elsewhere, up to 500 m (Figure 4.7). The highest recruits yields were obtained in summer between 100 and 200 m, even though the same depths were prospected at different seasons.

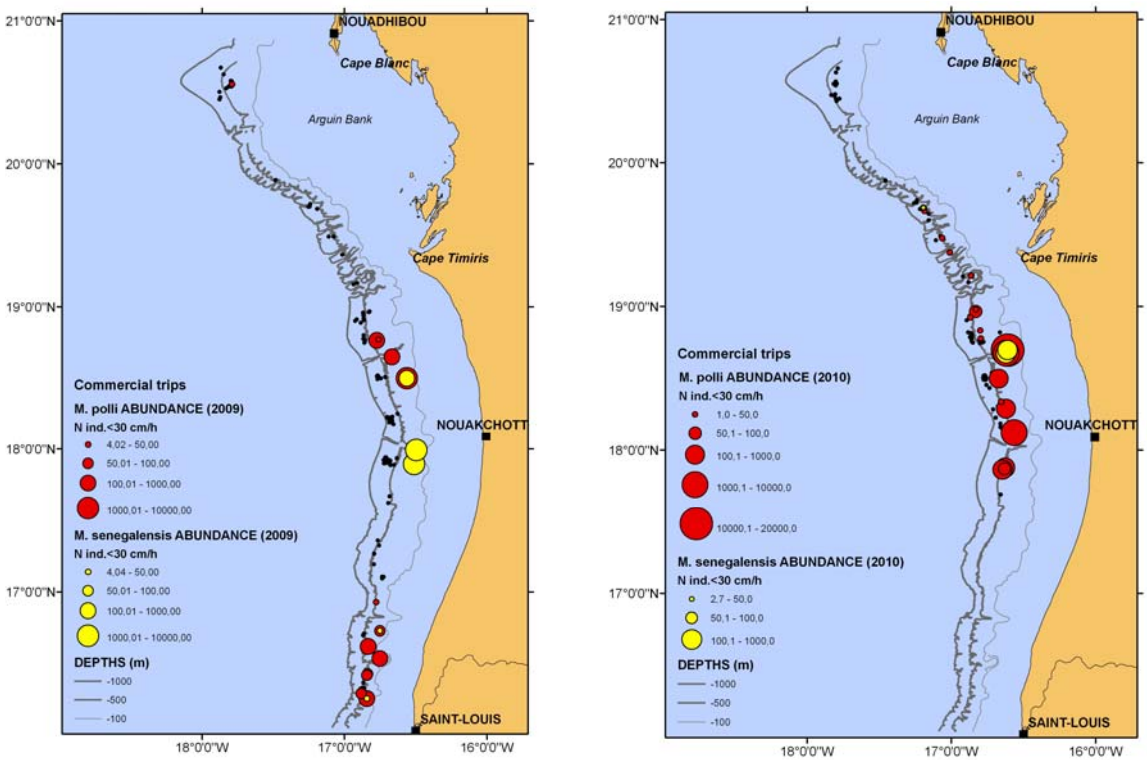

Figure 4.7. Spatial distribution of abundance (left) and yields (right) of *Merluccius polli* and *M. senegalensis* in Mauritanian waters. Data obtained from samplings of scientific observers onboard Spanish black hake trawlers in 2009 and 2010. Points indicate the trawls executed.

Hake discards by fishing trip were highly variable, ranging from 0.3% to 36% of total hake catch. Regarding the nine sampled commercial trips, the discarded hake reached 37 t (averaging 12% of total hake catch). A substantial fraction of hake discards is composed by commercial-sized specimens damaged during the fishing. During these nine trips, the discard of small-sized specimens ranged from 17% to 65% of the total hake discarded. As a whole (considering recruits and damaged specimens) 90% of the discarded hake was of *M. polli*, a similar proportion than in the commercial catch.

All hauls (250) performed during these nine commercial trips are represented by depth in Figure 4.8, evidenced that fishing operations are mostly located beyond 400 m.

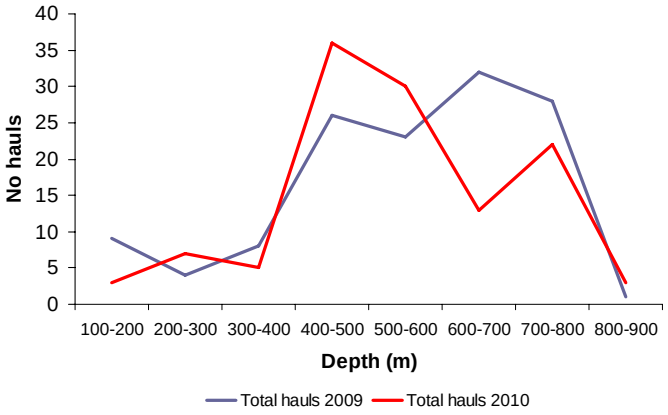

Figure 4.8. Number of hauls by depth strata. Data of the scientific observers onboard commercial trawlers (9 fishing trips during 2009 and 2010).

GUINEA-BISSAU

M. polli has been a significant by-catch of the European cephalopod freezer fleet, mainly the Spanish one, and eventually an opportunistic catch when the targeted cephalopod species were achieving low yields. Nevertheless, hake catch has abruptly dropped in 2009 and 2010, and is currently almost negligible. Figure 4.9, shows the mean monthly hake catch of the cephalopod and shrimper fleets in 2007 and 2008, evidencing that the hake catch of the shrimpers was irrelevant for the shrimper fleet. CPUE has not been represented since black hake by-catch data are not generally available. The cephalopod freezer trawlers fished significant quantities of hake as by-catch: 800 and 600 kg/fd in 2006 and 2007, respectively.

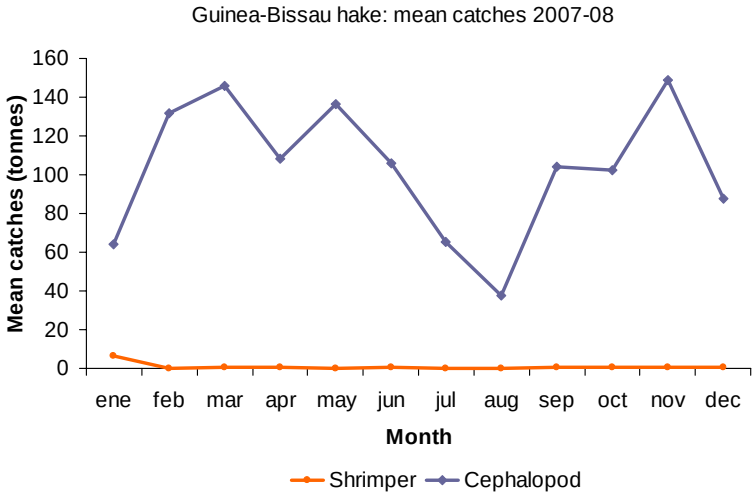

Figure 4.9. Black hake (*M. polli*) mean catch of the EU freezer shrimper and cephalopod trawl fleets in Guinea-Bissauan waters, from 2007 to 2008.

The decrease of black hake catch in summer and winter recorded for the cephalopod freezer trawlers is due to the migration of the fleet to Mauritanian fishing grounds during the seasonal closing of the Guinea-Bissauan fishery. The effects of this seasonal closure for the biological recovery of the stocks are also perceptible in the decrease of the fishing efforts over these periods (see Document Cephalopod and Crustacean stocks, Section 4.2.2.b, Figure 4.24).

The Chinese fleet, significantly present in the area, does not reported any catch of black hake in its fishery statistics.

Figure 4.10 shows that the Spanish cephalopod fleet hake daily yields (kg/h) were in 2007 and 2008 mainly located in two close areas: one in the north (12º 30’ N - 11º 00’ N), mostly between 200 and 500 m depth, and another one in the south (11º 00’ N- 09º 30’ N), roughly around the 500 m isobath. Nevertheless, when this fleet is targeting cephalopods generally operates at shallower grounds, up to 200 m.

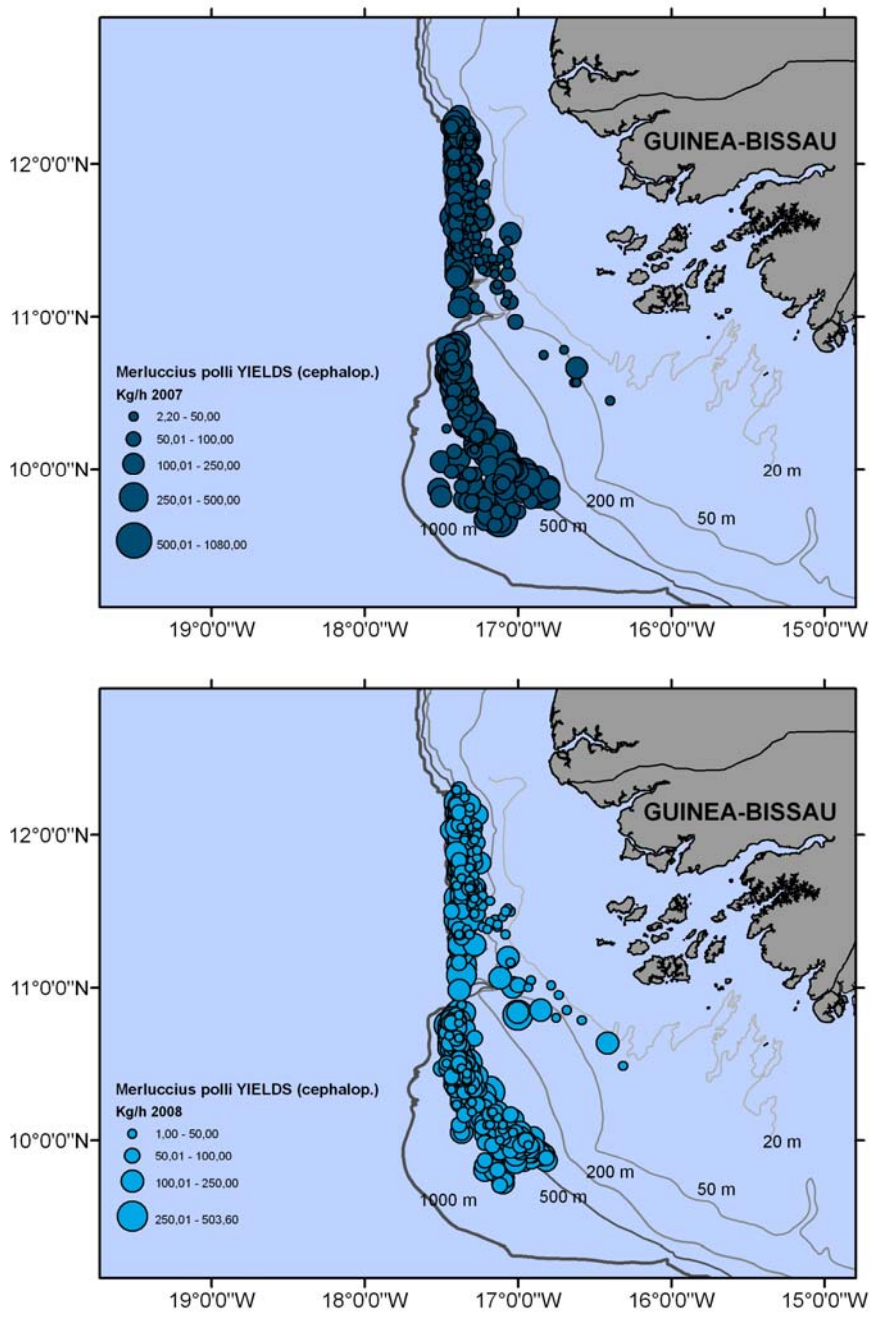

Figure 4.10. Spatial distribution of yields (kg/tour) of *M. polli* obtained by the Spanish cephalopod fleet in Guinea-Bissau. Years 2007 (up) and 2008 (down)

The highest *M. polli* catch achieved by the Spanish cephalopod fleet from 2005 to 2008 is probably one of the main causes of the obvious decrease recorded for the black hake biomass at depths comprised between 200 and 500 m.

The Spanish shrimper fleet, although to a much lesser extent, also harvested black hake in the same areas, and in southern areas mostly in waters deeper than 500 m (being here an obvious commercial by-catch of the vessels fishing for *Aristeus varidens* in these grounds) (Figure 4.11).

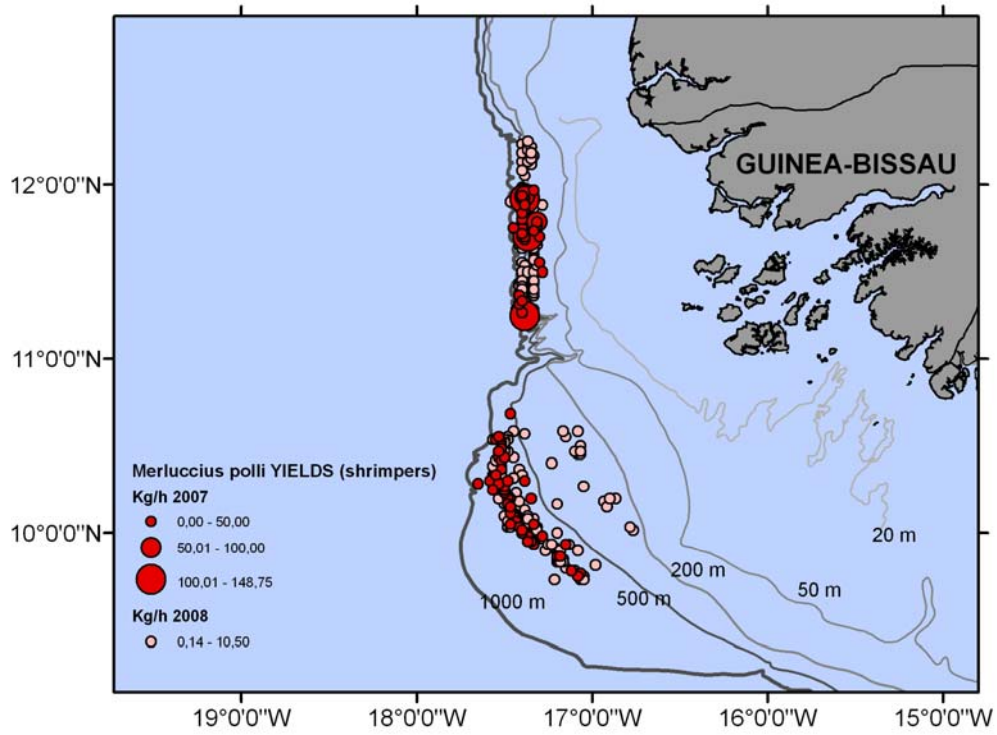

Figure 4.11. Spatial distribution of yields (kg/hour) of *M. polli* obtained by the Spanish shrimper fleet in Guinea-Bissau during de period 2007 and 2008.

4.1.3. Hake Fisheries Conclusions

European hake –Moroccan stock

The currently in force fishing agreement EU-Morocco is not contemplating the bestowal of fishing licences for the European hake, even if this species was one of the most relevant resources for the EU fleet (mostly Spanish) before the older agreements were due to expire by 1999. The 2008 over-exploitation status of the Moroccan *M. merluccius* stock evidenced in the last assessment showed that no surplus was available for any foreign fleet under the currently exploitation scheme. In addition, the current situation is totally unknown because neither Moroccan detailed fishery data nor periodic scientific survey data are available to us.

However, we know that Moroccan authorities are adopting more protection measures of the European hake resources and are preparing a specific management plan, which is expected to be implemented by the end of 2011. A similar management plan was already implemented in December 2010 for the shrimp fisheries, which harvest the European hake as by-catch.. We also think that the Moroccan authorities are promoting a stabilization, and even a reduction, of the fleets exploiting this resource. We also think that, in addition to the dramatic over-exploitation exerted on the European hake stock, the climatic conditions of the last decade have had a negative effect on it . (Meiners *et al.*, 2010). We expect that the implementation of adequate management measures will

help the stock to recover, and this recovery will be enhanced if the climatic conditions were favourable in future years.

The management for the recovery of this stock should envisage strong measures for protecting the recruitment in the coastal strip, both permanent (in certain areas) or seasonal (in the recruitment spring-summer periods). The seasonal protection of the spawners should also be envisaged, but as this species is a continuous spawner, we would need all the biological information gathered in the Moroccan scientific surveys to precisely fix the areas and seasons to be closed to fishing. If foreign fleets (e.g., UE) would return to Moroccan waters to harvest the European hake resources, all the measures should be enforced for all the operating fleets, including the Moroccan ones. In any case should the enforced measures be different for domestic and foreign fleets, especially because they usually fish following the same strategies.

Currently and with the data available, we are unable to propose a better scientific assessment.

Black hake (*Merluccius senegalensis* and *M. polli*) - Moroccan stock

We think that the closed areas imposed by the fishing agreement (trawling at depths over 200 m and longlining outside the 12 nautical miles area) are adequate measures for the protection of the recruit.

However, the closed seasons currently enforced during the same periods than for the cephalopod trawlers (May-June and September-October) is not an effective measure, since neither the recruits nor the spawners are protected with this temporal fishing ban. We think that a winter closed season (of 1 or 2 months, mainly in November-December or January-February) or even the temporal closing of the fishing depths over 400 m for trawlers during these winter months, will be a better and more safely way of protecting the spawners.

In addition, the single vessel fishing for black hake in Moroccan waters was fishing at great depths, thus self-imposing a greater spatial limitation than the enforced one. In fact, the average size of the black hake caught from 2008 to 2010 was of 47 cm, 2 cm above the average size for the black hake in Mauritanian waters.

Again, the availability of the black hake data obtained in the Moroccan periodical scientific surveys will enable to accurately adjust these protective measures.

Black hake (*Merluccius polli* and *M. senegalensis*) – Mauritanian stock

The spatial limitation established for this stock in the current in force fishing agreement (see Section 5) is adequate for protecting the recruitment. If, in addition to this, the fleet maintains its fishing strategy of fishing at more than 400 m depth, we think that the imposed closed areas are an effective measure.

However, we think that the closed areas are not totally protecting the spawners, since the extension of the closed area beyond 19º15,60N (see Section 5) during the closed season imposed for the cephalopod trawlers (May-June and September-October) is not suitable for this resource. As explained for the Moroccan stock, a more effective measure for protecting the black hake spawners will be a winter closed season (November-December or January-February). This measure could be enforced only for a fraction of the fleet, if the number of vessels surpassed 10, thus limiting the access to the area and reducing the fishing effort. Currently, as there are only 2 vessels operating, this measure is not necessary.

However, we must not forget that the more coastal species (*M. senegalensis*) and the juveniles of *M. polli* overlap in the coastal area, where they are abundant and heavily harvested by the number of fleets operating here, thus endangering the recruitment of both black hake species. So, even if closed seasons

or closed zones are imposed for the directed fisheries, the recruits of black hake species will be heavily exploited as by-catch by hardly controlled fleets

Black hake (*Merluccius polli*) – Guinea-Bissauan stock

Black hakes are a significant by-catch of the EU cephalopod freezer trawlers, which opportunistically target this species achieving high catch levels from 2005 to 2008. Even if *M. polli* is not considered as a target species and if we do not have many biological information about this species in Guinea-Bissauan waters, we think that a closed area could be enforced for the cephalopod trawl fleet, at least seasonally.

When targeting cephalopods, this fleet is normally operating at depths under 200 m, so the enforcement of a closed zone in depths over 200-250 m should not affect its fishing strategy but will minimise the catch of *M. polli*.

We do not think that other seasonal protective measures are necessary, since this resource is a by-catch species for the diverse fleets operating in Guinea-Bissau.

4.2. OTHER DEMERSAL FISHERIES FOR FINFISH AND ELASMOBRANCHS

4.2.1. Biological information on the species

Sparidae, Sciaenidae, Trichiuridae, Rajidae and sharks

MOROCCO

Very little is known about the ecobiology of these finfish and elasmobranch species in Moroccan waters. No landing statistics nor spatial fishery activity information are either available, as this group of species belong predominantly to Moroccan fleet by-catch. In addition, being exploited as by-catch, it is unrealistic to set regulatory measures addressed for their conservation but enforced for fleets that are not directed to them, as is the Moroccan cephalopod freezer trawlers' fleet. Thus, no closed areas or seasons guidelines could be provided for these species.

***Pagellus* spp. and *Solea* spp.**

GUINEA-BISSAU

The knowledge of the ecobiology of these species in Guinea-Bissauan waters is null. We only have biomass estimations and spatial distribution collected during two Spanish research surveys carried out onboard the R/V Vizconde de Eza in the area in November-December of 2002 and 2008 (García-Isarch *et al*., 2009). In these surveys, *Pagellus bellottii* was the only species found from genus *Pagellus.* Concerning *Solea* spp. we have already explained that this species has been entirely absent from the surveys and is never recorded in the fishery statistics. In consequence, Pleuronectiformes have been analysed as a whole, as some uncertainty exists about which flatfish species are commercially exploited

Spatial distribution and biomasses

***Pagellus bellottii* and Sparidae**

Biomass by depth strata showed that the maximum values were found between 50 and 200 m in both surveys, a stratum which recorded a biomass increase from 2002 to 2008. In the shallowest stratum (<50 m) we also observed a significant increase (329%) in the biomass values between both surveys (Table 4.IV).

Table 4.IV. Estimated biomass (in tons, t) by depth strata and total area of *Pagellus bellottii* in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

Survey	< 50 m	50 - 200 m	Total area
BISSAU 0210	191	1174	1365
BISSAU 0810	628	1340	1968

These biomass values could be indicative of a healthy stock, even though the mean total lenght (TL) of *P. bellottii* individuals decreased between both surveys from 17.5 cm (2002) to 13.6 cm (2008).

From geo-referenced survey data, the northern area was identified during both surveys as the main location for *P. bellotti*, from 50 to 200 m, being absent at greater depths. In shallower waters (<50 m) it occurred southwards dispersedly, mostly in 2002. Therefore, this species share the bathymetrical range of the cephalopod species targeted by cephalopod freezer trawlers (Figure 4.12).

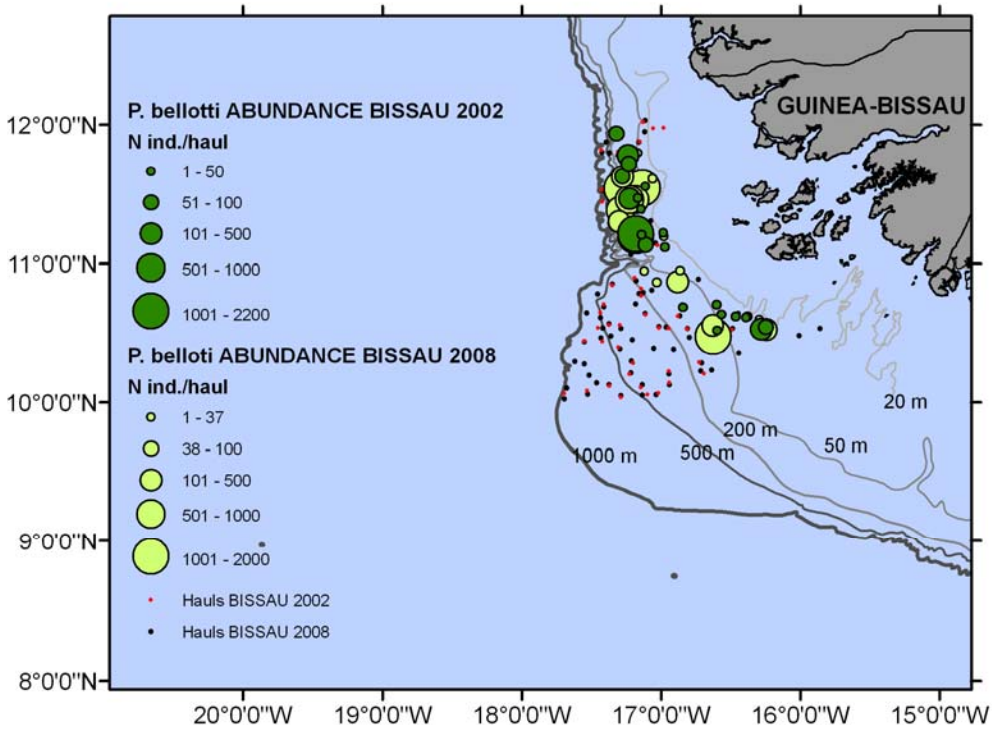

Figure 4.12. Spatial distribution of abundances (No ind./haul) of *Pagellus bellottii* in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

When considering the sea breams (Sparidae) as a whole (and excepting *P. bellottii*), an increment in total biomass is observed from 2002 to 2008, although the population located in the shallowest stratum has disappeared (Table 4.V). The sea bream species found (2008 survey) were mainly those belonging to Genus Dentex, with *D. maroccanus*, *D. congoensis* and *D. angolensis* being fished between 50 and 200 m depth, and *Pagrus coeruleostictus* in shallower waters (<50 m). Sparidae biomass values were very concentrated (99% in 2008) between 50 and 200 m, a stratum which recorded again a biomass increase (Table 4.V). The mean sizes (TL) of *D. maroccanus*, the most abundant species among Sparidae, ranged from 11 cm (2002) to 17 cm (2008).

P. bellotti and the other Sparidae species were found in the same depth range as the cephalopod species.

Table 4.V. Estimated biomass (in tons, t) by depth strata and total area of Sparidae in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

Survey	< 50 m	50- 200 m	200 – 500 m	Total area
BISSAU 0210	202	10886	228	11315
BISSAU 0810	0	13795	138	13933

Pleuronectiformes

The total biomass of this group decreased in 9% from 2002 to 2008, even if noteworthy differences were found among depth strata (Table 4.VI). In the 200-500 m depth range, the biomass of flatfish was reduced in more than a half, as observed for sea breams and hake, whose biomass abruptly dropped at these depths. It is likely that this depth range is the one suffering the highest fishing pressure, mostly exerted by the cephalopod fleet, when fishing for their target species.

Table 4.VI. Estimated biomass (t) by depth strata and total area of Pleuronectiformes in Guinea-Bissauan waters during the Spanish research surveys carried out in 2002 and 2008. (Spanish R/V *Vizconde de Eza*).

Survey	< 50 m	50- 200 m	200 – 500 m	500 – 1000 m	Total area
BISSAU 0210	576	2151	1242	35	4004
BISSAU 0810	1245	1860	541	12	3657

4.2.2. Information on seasonal and spatial distribution of the fleets fishing demersal finfish

GUINEA-BISSAU

Pagellus bellottii and Sparidae

There are hardly any records of these species in the fishery statistics, where only one item is for *Dentex.* Chinese fishing vessels, from both shrimper and cephalopod fleets, declare significant catches of *Dentex* spp., though only account for 3 or 5 % of their total catch. The Spanish cephalopod trawlers declared a catch of 161 t of Dentex (2007), accounting for almost 3% of the total catch.

We think that catches of these species are largely understimated. In fact, *Dentex* spp. is a valuable resource which is among one of the most fished by IUU (Illegal, Unreported and Unregulated fishery) in the whole area.

No advice can be providen on closed areas or seasons due to the lack of data.

Pleuronectiformes

Data concerning mean monthly catch of flatfish due to EU fleets (shrimper and cephalopod trawlers) from 2007 to 2008 are presented in Figure 4.13. Pleuronectiformes are the first and second most important groups within by-catch of shrimper and cephalopod fleet, respectively. Being accessory catches, no CPUE data are presented here.

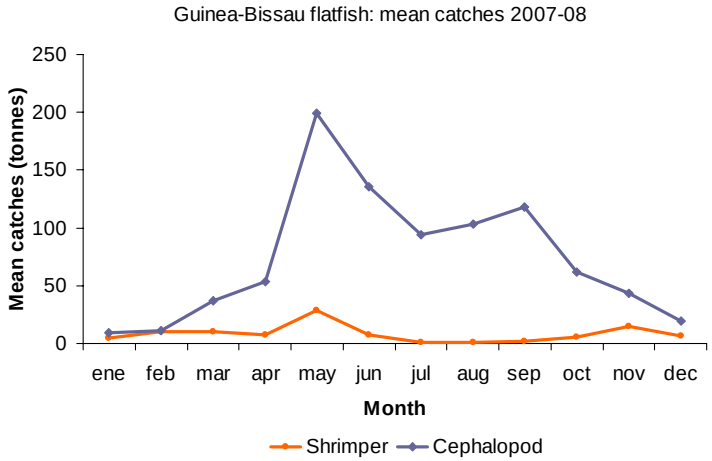

Figure 4.13. Mean catches of flatfish (Pleuronectiformes) in Guinea-Bissauan waters made by EU fleets (freezer shrimpers and cephalopod trawlers), from 2007 to 2008.

As shrimper fleet performs an adequate targeted activity, it has a low by-catch and consequently achieves low flatfish catch (Figure 4.14). On the contrary, cephalopod fleet has showed to opportunistically target non-cephalopod species (when the cephalopod yields were low), punctually fishing significant volumes of by-catch (maximum mean around 200 t in May) mainly composed of hake and flatfishes. As described for hake, the catch of Pleuronectiformes drops again during summer and winter, when the fishing effort moves to Mauritania. These results highlight the fact that while the closed seasons are effective in Mauritania (May-June and September-October), they provoke an increase of the fishing pressure on both hake and flatfish resources in Guinea-Bissauan waters, since they become target species for the cephalopod trawlers moving to Guinea-Bissau.

For Chinese fleets, flatfish are also main species of their multi-species fishery, whatever the fishing licence they have.

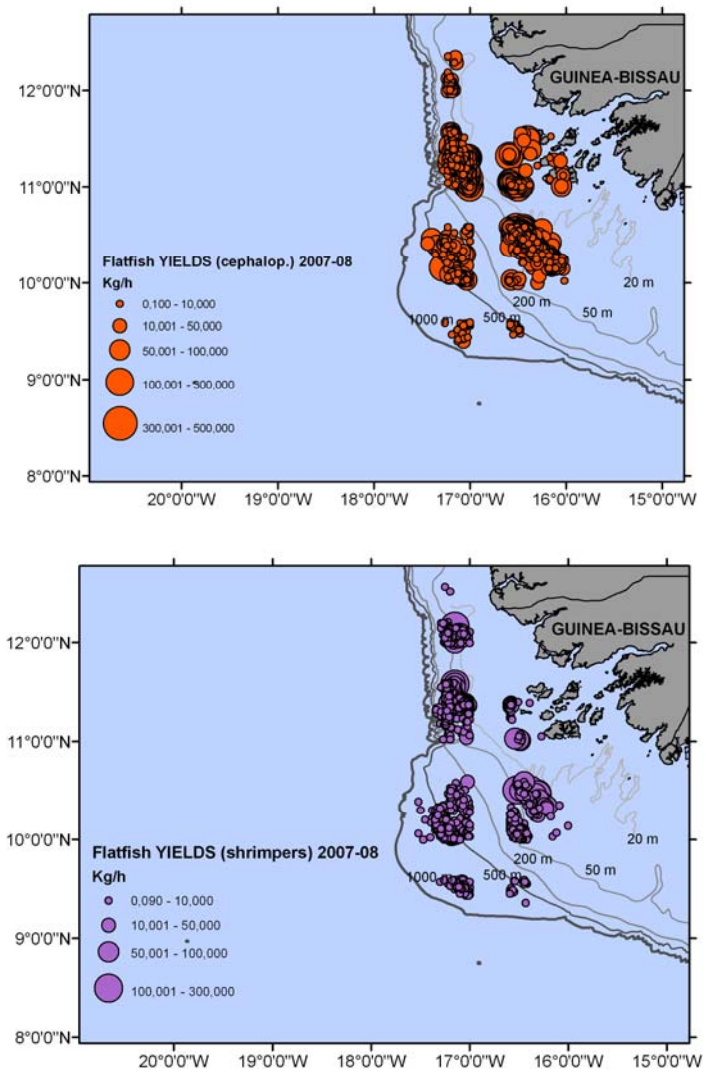

Figure 4.14. Spatial distribution of yields (kg/hour) of Pleuronectiformes obtained by the Spanish cephalopod (up) and shrimpers (down) fleet in Guinea-Bissau. Years 2007 and 2008.

The spatial yields (kg/hour) show a high fishing pressure of both EU fleets over these species, mainly concentrated in four areas, some of them coincident with the fishing grounds of their target species (shrimps or cephalopods), but others totally different (see Document Crustacean and Cephalopod stocks, Section 4.2.2.b., Figure 4.26 and 4.27) (Figure 4.14). This may indicate that both shrimper and cephalopod trawler fleets can specifically direct their fishing to flatfish in some occasions. Nevertheless, the group of Pleuronectiformes is highly exploited in the shallowest depth stratum (<50 m) (Figure 4.14), where surprisingly we observed a biomass increase of 216% from 2002 to 2008 (survey data).

4.2.3. Other Demersal Finfish Conclusions

Sparidae –Guinea-Bissauan stock

In absence of more ecobiological and fishery data about these group of species exploited as by-catch, we are unable to provide advice on regulatory measures (closed seasons and/or closed areas) for the protection of these resources.

However, we must say a word about the unexpected increase in Sparidae biomass observed between 2002 and 2008 Spanish research surveys. We think that there might be a density-dependent relationship between the sea bream populations and the cephalopod ones, because of their trophic interactions and their bathymetrical distribution ranges overlapping to a great extent. In fact, the fleets operating in Guinea-Bissau have achieved significant cephalopod catches to date, but the current decrease in the yields of their target species has forced the cephalopod freezer trawlers to opportunistically target other demersal species (mainly Sparidae and Pleuronectiformes).

To explain the increase in the sea breams abondance in spite of the high fishing effort exerted on their bathymetrical range of distribution (<50-200 m), we could hypothesize a replacement of cephalopods by Sparidae. If the increases in cephalopod productivity can dramatically impact the trophic structure of marine ecosystems (Hunsicker, 2009), we can imagine that the decrease of the cephalopod abundances will lighten their trophic impact on commercially valuable fishes, such as sea breams.

As a matter of fact, the opposed phenomenom has already been observed in the 1960s, when the decline in the sea bream's catch (formerly the main resource) in the northern fishing grounds of North West Africa was associated with an increase in the cephalopod's catch (whose exploitation had just begun). The possibility of a replacement of Sparidae by cephalopods was then suggested by a number of authors (Bas et al., 1970; Balguerías, 1985; FAO, 1986).

Pleuronectiformes – stock Guinea-Bissau

The closed zone (>200-250 m) proposed to cephalopod freezer trawlers to limit their hake catch could also be useful to reduce the catch of flaftishes in this heavily exploited bathymetrical range (200-500 m). In fact, the abundance of Pleuronectiformes was reduced at these depths in 56% from 2002 to 2008 (Spanish survey data)

No other regulatory measures can be addressed for flatfishes (Pleuronectiformes), as they are one of the most significant groups in the by-catch of all fleets operating in the area.

5. IS MANAGEMENT OF THE DEMERSAL HAKE AND FINFISH STOCKS IN ACCORDANCE WITH THE MARINE STRATEGY FRAMEWORK DIRECTIVE (ENVIRONMENTAL PILLAR OF THE INTEGRATED MARINE POLICY) TO ACHIEVE GOOD ENVIROMENTAL STATUS BY 2020?

The First step to assess if the management of the hake and finfish stocks is in accordance with the Marine Strategy Framework is the analysis of the management measures currently in force.

The management measures established for hake and finfish demersal fisheries in Morocco, Mauritania and Guinea-Bissau are included in the regulations included in the Protocols of Fisheries Agreement between the European Community and those countries.

Once these management measures have been reviewed, next step will be to know if they are in accordance with the Marine Strategy Framework Directive (MSFD)[8] to achieve Good Environmental Status (GES) by 2020. **Descriptor 3** is identified as one GES descriptor covering aspects of marine environmental status impacted by fishing, as explained in Part B of the Annex of the COMMISSION DECISION (2010/477/EU) on criteria and methodological standards on GES of marine waters. Descriptor 3 is defined as: **"Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock".** Therefore, the estimations of the parameters used as criteria for assessing progress towards GES for Descriptor 3 are presented here.

Morocco, Mauritania, and Guinea-Bissau are considered separately because of the existence of some differences, explained below.

5.1. MOROCCO

5.1.1. Moroccan Management Measures

The current management measures for the demersal fleets targeting hake and other finfish affecting the EU vessels are included in the current Fishery Agreement between the European Community and the Kingdom of Morocco (OJ L 141, 29.5.2006, p. 4–37)[9] under three Types of fishing: "Small-scale fishing/north", "Small-scale fishing/south" and "Demersal fishing". Nevertheless, the fishing conditions for each category shall be agreed each year before the issue of licences.

More management measures to protect this stock are progressively being established by the Moroccan authorities. A management Plan for shrimps (especially targeting the protection of the deep-water rose shrimp) was established in December 2010 (Decision Ministerielle Nº 001/CR/10). This plan affects the fleets that capture hake, mainly European hake, and other demersal species as by-catch. We know that another Management Plan for hakes is currently under elaboration.

[8] DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

[9] Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Kingdom of Morocco (OJ L 141, 29.05.2006, p. 9–37)

As far as we know, current management measures affecting hake and other demersal finfish fisheries for the Moroccan fleets are in force since 1992. They mainly consist of technical measures concerning gear type, and minimum mesh sizes (50 mm for coastal trawlers; 70 mm mesh size and 1000 m maximum length for artisanal trammel nets). Neither there are closed seasons nor catch limits. The possibility of establishing minimum landing sizes for all demersal species is currently under study. .Moroccan fleets are not allowed to fish in waters shallower than 80 m (from Tangier to Al Hoceima) and inside the 3 nautical miles (from Al Hoceima to Saidia and between Tangier to Lagouira).

Regarding closed areas, some vulnerable zones near Al Hoceima are protected as Marine Protected Area (MPA). Furthermore, trawling is banned in the area of artificial reefs between Cala Iris and Martil.

Current management measures for hake and other finfish EU fisheries in Morocco include: a) Management measures of access to the fisheries and b) Technical management measures.

a) Management measures of access to the fishery

The system of fishing effort control currently in force in Morocco is based on the use of fishing licences. The current system of access to the fishery is based on the control of nominal effort, in terms of number of vessels authorized per size-type. The obtaining of a fishing licence is subordinate to the payment of certain fees.

For foreign fishing trawlers, the obtaining of a licence requires the existence of previous conventions or agreements between States or private agreements. This is the case of the EU vessels, which operate in the Moroccan EEZ into the framework of Fishing Agreements between the EU and Morocco. The EU shipowners pay certain fee (established in the Agreement) for obtaining their fishing licences.

The number of authorized vessels or licences per type of fishing and type of vessels are:

▪ Fishing datasheet No 2: “Small-scale fishing/north”. There are two categories depending on the type of vessel:

- <40 GRT: 27 licences.
- > 0 GRT and <150 GRT: three licences.

▪ Fishing datasheet No 3: “Small-scale fishing/south”. The number of authorized vessels is 20, all of them < 80 GRT.

▪ Fishing datasheet No 4: “Demersal fishing”. The number of vessels authorized is 22 with a maximum of 11 trawlers per year, with average size of 275 GRT

b) Technical management measures

The technical management measures currently implemented in the Moroccan EEZ are of five main types: closed areas, closed seasons, minimum catch size, gear types, and by-catch limitations.

b.1. - Closed areas:

The Fisheries Partnership Agreement between EU and Morocco establishes Fishing Zones, out of where the EU vessels are not allowed to fish. These are:

- For the “Small-scale fishing/north”, north of latitude 34º 18’ N, beyond 6 nautical miles.

- For the “Small-scale fishing/south”, south of latitude 30º 40’ N, beyond 3 nautical miles.

- For “Demersal fishing”, the geographical limit is at south of 29º N, beyond the 200 m isobath for trawlers (and 12 nautical miles for longliners).

b.2. - Closed seasons:

The closed season established for the "Small-scale fishing/north" is from 15 March to 15 May. The fishing type "Demersal fishing" (targeting black hakes) is adjusted to the closed seasons established for cephalopods and only applicable to trawlers. Therefore, the biological characteristics of black hake species have not been taken into account for its implementation. The Fishing Agreement contemplates 2 closed seasons (of 2 months each one) for the recovery of the stocks established in May-June and September-October. Finally, there is not closed season for "Small-scale fishing/south".

b.3. - Minimum catch size (minimum legal size, MLS):

This regulatory measure is set to minimize the catch of juveniles and immature specimens.

Depending on the type of fishing licences, the target species are different and given below.

- Target species for "Demersal fishing": black hake, scabbardfish, and leerfish/bonito.
- Target species for "Small-scale fishing/north": Scabbardfish, Sparidae and other demersal species
- Target species for "Small-scale fishing/south": Croaker and Sparidae.

In addition, a landing requirement is in force only for the fishing licence "Demersal fishing", establishing that 50 % of catch have to be landed in Morocco.

It is worth reminding that first maturity sizes are generally unknown for most of the Moroccan exploited stocks. Therefore, biological studies should be aimed at establishing minimum catch sizes in agreement with the species' biology.

Moroccan regulations establish MLS for some species targeted by demersal fleet (Bulletin Officiel, 2010)[10]:

Black hake (*Merluccius senegalensis*)	25 cm (TL)
European hake (*Merluccius merlucius*)	25 cm (TL)
Axillary seabream (*Pagellus acarne*)	17 cm (FL)
Lepidopus caudatus and *Trichiurus lepturus*	50 cm (TL)
Dentex (*Dentex* spp.)	20 cm (FL)

Total length (TL) is considered the length from the tip of the snout to the end of the caudal fin.

[10] Arrêté du Ministère de l'Agriculture et de la Pêche Maritime nº 3083-09 du 12 moharrem 1431 (29 décembre 2009) modifiant et complétant l'arrêté nº 1154-88 de 20 safar 1409 (3 octobre 1988) fixant la taille marchande minimale des espèces pêchées dans les eaux marocaines. (BO Nº 5822-. 1er rabii 1431, 18-3-2010, p. 245–249)

b.4. - Gear types

For "Small-scale fishing/north", there are two types of categories of bottom longline, the authorized gear:

- Type of vessel <40GRT: Maximum authorized number of hooks per longline is 2000.
- Type of vessel >40GRT <150GRT: The maximum authorized number of hooks per longline will be decided at a later date by the Joint Committee in accordance with scientific advice and Moroccan law.

In "Small-scale fishing/south" the authorized gear are line, pole, and traps, limited to a maximum of two gear types per vessel. In this type of fishing the use of longlines, trammel nets, fixed gillnets, driftnets, "trolls", and croaker nets is prohibited. The authorized net is an 8 mm mesh size net for catching bait, beyond 2 nautical miles.

Industrial fishery authorized gears for black hake (license "Demersal Fishing") are bottom trawl and bottom longline. Minimum authorized mesh size for hake trawlers is 70 mm. Both doubling of the cod-end and doubling of the twine forming the cod-end are prohibited. The Joint Committee in accordance with scientific advice and Moroccan law will decide the maximum authorized number of hooks per longline at a later date.

b.5. - By-catch limitations

The by-catch limitations are included in the Protocol of the Fishing Agreement between the EU and Morocco. In accordance with Moroccan law, the percentage of by-catch shall be calculated at any time during fishing trip according to the total live weight of the catch onboard.

Cephalopods and crustaceans are prohibited, with the exception of crab (5%) in "Demersal fishing". Swordfish and pelagic sharks are prohibited for "Small-scale fishing/north". The limitations of by-catch for "Small-scale fishing/south" are 0% of cephalopods and crustaceans, with the exception of 10% of crab; targeted fishing for crab is prohibited and 10% for other demersal species.

5.1.2. Descriptor 3

"Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock".

For this descriptor, the three criteria for assessing progress towards GES and the indicators related to them are the following:

1) **Level of pressure of the fishing activity**

- **Primary indicator**: **Fishing mortality (F)**

This indicator (F) is based on the fact that F values are equal to, or lower than, F_{MSY}, the level capable of producing (MSY), for achieving or maintaining GES. This means that in mixed fisheries and where ecosystem interactions are important, long-term management plans may result in exploiting some stocks less than at F_{MSY} levels in order not to prejudice the exploitation at F_{MSY}, of other species. This indicator due be estimated either from appropriate analytical assessments based on the analysis of catch at age or at length and ancillary information or from scientific judgment of F values associated to the yield-per-recruit curve (Y/R), combined with other information on the historical performance of the fishery, or on the population dynamics of similar stocks. However, although none of these assessments are currently used in the FAO/CECAF demersal assessments Working Groups, the Biomass Dynamic model applied

(BIODYN), used as a standard assessment model in these working groups, enabled the estimations of both F and F_{MSY}, as well as the analysis of historical trends of both parameters. For finfish species, the indicator value is given for the three species whose stocks have been assessed (see Table 5.I).

Table 5.I. Values of F in relation to F_{MSY} (F/F_{MSY}), as estimated in the successive assessments of hakes and other finfish Morocco stocks, since 1999 to nowadays. Years correspond to the last year of data used in the assessments.

Stock/Last Year	1999	2002	2004	2006	2008
M. merluccius- Morocco	-	58%	93%	276%	334%
Merluccius spp.- Morocco	163%	-	-	-	-
P. acarne - Morocco	-	-	-	281%	227%

For hakes and sea bream Moroccan stocks, the observed trends of the index F/F_{MSY} indicate:

- ***M. merluccius* - Moroccan stock**: F/F_{MSY} has progressively increased, from values where the F was able to produce the MSY (58%) to values of 334%, where the F is well above the F that would produce the MSY (F_{MSY}). In fact, the 2010 assessments (FAO, 2010, in edition) showed a strong over-exploitation of the stock, as the F exerted on European hake would not achieve the MSY. This fact could also be attributed to the great number of different Moroccan coastal vessels targeting this species, in addition to the small Moroccan artisanal fleet, whose unknown catches are probably significant.

- ***Merluccius* spp. - Moroccan stock**: No temporal series are available, as the last assessment was carried out in the 2003 FAO/CECAF Working Group. The estimations of the index F/F_{MSY} correspond only to this assessment (described in previous sections) and were attempted including the last data series available from 1983 to 1999 to the end of fishing Agreement. F was much higher than F_{MSY} (F/F_{MSY}= 163 %). This means that, considering the assessed situation of over-exploitation, F should be reduced for the recovering of the stock. From 2000 to 2003, there were no fleets exploiting this resource and since 2004, only a Moroccan fleet has been fishing European hake as by-catch. Since 2007, only one vessel has licence to target this species. Therefore, compared to the previous situation (until 1999) F has probably been reduced because of the fleet decline over the last years.

- ***P. acarne* - Moroccan stock**: We only have two indicators estimated in 2 previous FAO WGs (FAO, 2007 in edition and 2010, in edition). The 2004 WG (FAO, 2006) estimated the F_{cur}/F_{SYcurB} value (50%), but did not estimate the F/F_{MSY} value for this assessment. Thus, no comparisons are possible between these estimations and the subsequent ones. The indicator value decreased from 2006 (281%) to 2008 (227%), probably due to the reduction of the effort exerted by the cephalopod fleet (the main fleet fishing this species) as a consequence of the extension (2 months more per year) of the closed season enforced by Moroccan regulations. Despite this decrease, the current indicator is still very high because F was more than twofold the F_{MSY}, as the stock was over-exploited. The F value exerted would not achieve the MSY of *P. acarne* and should be reduced.

We could think that this indicator could be useful for the management of Morocco, but taking into account certain restrictions, such as the fact that F estimations are only based on declared catches and thus and are not considering all the removals from the stock (including discards and

undeclared catch). Efforts should be made to achieve better estimations of real catch to consider the use of F as a good indicator of the stocks' health in Moroccan waters.

In fact, it is worth mentioning that CECAF management recommendations to the Coastal States are based on fishing effort and therefore, on the fishing mortality (F). However, CECAF decisions are not mandatory and not binding on the member states.

2) **Reproductive capacity of the stock**

- **Primary indicator**: **Spawning Stock Biomass (SSB) -** The SSB should be estimated from appropriate analytical assessments based on the analysis of catch at age or at length and ancillary information. As explained above, no analytical methods are currently used to assess the CECAF stock status, which makes impossible the use of this indicator.

  Three demersal trawl surveys were carried out onboard the Spanish R/V Vizconde de Eza from 2004 to 2006 in 3 different adjacent areas along the Atlantic coast (from 36º N to 21º N). The SSB estimated from the results of these 3 surveys, could not be used because the campaigns surveyed three different zones in three different dates. Furthermore, the required parameters, such as length composition in catch, length/weight relationship and the maturity logistic curve could not be obtained for the species in Morocco.

- **Secondary indicator*s*** (if analytical assessments yielding values for SSB are not available): **Biomass indices, which can be used if they can be obtained for the fraction of the population that is sexually mature.** To estimate this secondary indicator we would need knowledge on the population structure and first maturity sizes of the different stocks and, a biomass index for every exploited stock. However, none of these data is jointly available for any of the studied Moroccan stocks. In fact, sizes at first maturity are available from the literature for the 4 species, but their population structure is still unknown because their distribution area was not fully prospected by the Spanish deep surveys.

3) **Population age and size distribution**

- **Primary indicators**: **Indicators based on the relative abundance of large fish**. These indicators could not be estimated for any of the Moroccan stocks:

  i) Proportion of fish larger than the mean size of first sexual maturation- This indicator could not be estimated due to the lack of a reliable size at first maturity for these stocks.

  ii) Mean maximum length across all species found in research vessel surveys. There are no length frequencies of these species, since their distribution ranges are not covered.

  iii) 95% percentile of the fish length distribution observed in research vessel surveys. There are no length-frequencies of these species obtained in surveys.

- **Secondary indicator: Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation**. As explained in section 4, sizes at first maturation are unreliable or unknown for most of the Moroccan hake and finfish stocks. Furthermore, this indicator is not available for a time series, as required for a reliable analysis. This analysis, together with any other information on the biology of the species, should determine whether there is a high probability that the intrinsic genetic diversity of the stock will not be undermined.

  In spite of the scarcity of our data, Moroccan scientists carry out seasonal surveys in its ZEE every year, an excellent possibility of estimating the population age and size distribution based

on either direct estimations of SSB in these surveys, or by estimating the secondary indicator. In any case, efforts to improve the knowledge of the biology of the target species have to be made.

5.2. MAURITANIA

5.2.1. Mauritanian Management Measures

Most of the management measures for the industrial hake fleets affecting EU vessels are included in the current Fishery Agreement between the European Community and the Islamic Republic of Mauritania (OJ L 203, 31.07.2008, p. 4–59[11]) under the Fishing Category 2: "Black hake trawlers and bottom longliners", and this category does not include freezer trawlers.

Current management measures for black hake fisheries in Mauritania include: a) Management measures of access to the fisheries and b) Technical management measures.

a) Management measures of access to the fishery

The system of effort control used nowadays in Mauritania is based on the use of fishing licences. Mauritanian Fishing Law No. 2000-025 and its application decree nº2002-73 establish that the fishing activity is subordinate to obtaining a licence. The article 18 of this decree defines the different types of licences.

The current system of access to the fishery is based on the control of nominal effort, in terms of GRT for the industrial fleets and in terms of vessel length for the artisanal one. The obtaining of fishing licence is subordinate to the payment of certain fees. The authorized tonnage for black hake trawlers and longliners is 3240 GRT per year.

For foreign trawlers, the obtaining of a licence requires the existence of previous conventions or agreements between States or private agreements. This is the case of the EU vessels, which operate in the Mauritanian EEZ into the framework of Fishing Agreements between the EU and Mauritania. The EU shipowners pay certain fees (established in the Agreement) for obtaining their fishing licences. These fees are fixed for the four-year period of application of the Protocol.

A unique type of licence manages the hake fishery.

b) Technical management measures

The technical management measures currently implemented in the Mauritanian EEZ are of five main types: closed areas, closed seasons, minimum catch sizes, gear types, and by-catch limitations.

b.1. - Closed areas:

Certain marine areas of the Mauritanian EEZ have been protected, under the declaration of Marine Protected Areas (MPAs):

[11] Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania for the period 1 August 2008 to 31 July 2012. (OJ L 203, 31.07.2008, p. 4–59)

- Arguin Bank National Park: it is closed to all type of motorized fishing vessels. There is a law (Nº2000-024) that defines the conditions of the fishing activity into this maritime space that covers near 43% of the total non-trawlable area in the North zone (between Nouadhibou and Cape Timiris).
- Diawling National Parc and Chat Boul Reserve, where the fishing conditions are still in a developmental phase.
- The Satellite Reserve of Cape Blanc, closed to the fishery for the protection of the monk seal (*Monachus monachus*) colony.

Apart from these MPAs, which affects to all the national and international fleets, the Protocol of the Fisheries Partnership Agreement between EU and Mauritania establishes Fishing Zones, out of where the EU vessels are not allowed to fish.

The fishing area for the EU black hake trawlers and bottom longliners fleets is located:

- North of latitude 19° 15,6' N, outside the zone marked by the following points: 20°4 6,3' N-17° 03,0' W/ 20° 36,0' N-17° 11,0' W/ 20° 36,0' N-17° 36,0 W/ 20° 03,0'N-17° 36,0' W/ 19° 45,7' N 17° 03,0' W/ 19° 29,0' N 16° 51,5' W/ 19° 15,6' N 16° 51,5' W and 19° 15,6' N 16° 49,6' W.
- South of latitude 19°15.6' N as far as latitude 17°50.0' N, west of the 18-mile line, the coordinates of which are calculated on the basis of the 6-mile line, the coordinates of which are given in Appendix 6 to Annex II (OJ L 203, 31.07.2008, p. 4–59).
- South of latitude 17°50.0' N, west of the 12-mile line, the coordinates of which are calculated on the basis of the 6-mile line, the coordinates of which are given in Appendix 6 to Annex II (OJ L 203, 31.07.2008, p. 4–59).

The zoning during the closed periods for cephalopod fisheries is as follows:

- Between Cap Blanc and Cap Timiris, the exclusion zone is defined by the following points: 20°46.0' N-17°03.0' W/ 20°46.0' N- 17°47.0' W/ 20°03.0' N- 17°47.0' W/ 19°47.0' N-17°14.0' W/ 19°21.0' N- 16°55.0' W/ 19°15.6' N- 16°51.5' W and 19°15.6' N- 16°49.6' W.

From 2005 onwards, the extension of the reserved area for the artisanal fishery, where trawling is prohibited, was enlarged.

b.2. - Closed seasons

The Fishery Agreement between the EU and Mauritania contemplates two closed seasons, as recovering periods for both the cephalopod fishery. Two periods of 2 months each are enforced: May-June and September-October. However, during 2010, the Mauritanian authorities unilaterally switched the second closed season to the months of October and November. Black hake trawlers and bottom longliners only enlarge the closed area in the north in these periods (See point 5.2.1.b in this Section). Note that two months closed season for the biological recovery of hakes was in force between 1996 and 2005: September-October.

b.3. - Minimum catch size

This measure is aimed at minimizing the catch of immature specimens and juveniles.

Minimum catch sizes are established for the two target species of the black hake fleets: 30 cm TL for hake (*Merluccius* spp.). Total length (TL) is considered the length from the tip of the snout to the end of the caudal fin.

b.4. - Gear types

Industrial fishery authorized gear for black hake are bottom trawl and bottom longline.

Minimum authorized mesh size for hake trawlers is 70 mm, and there is not a minimal size of hooks for longliners. Both doubling of the cod-end and doubling of the twine forming the cod-end are prohibited.

b.5. - By-catch limitations

The by-catch limits are established by the Mauritanian legislation and included in the Protocol of the Fishing Agreement between the EU and Mauritania. In accordance with Mauritanian law, the percentage of by-catches shall be calculated at any time during fishing trip according to the total live weight of the catch on board.

Limitations of by-catch are 25% of fish for trawl vessels and 50% for longliners. Furthermore, the catch of cephalopods and crustaceans is prohibited.

5.2.2. Descriptor 3

"Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock".

For this descriptor, the three criteria for assessing progress towards GES and the indicators related to them are the following:

1) **Level of pressure of the fishing activity**

- **Primary indicator**: **Fishing mortality (F)**

  As explained above, the estimation of both F and F_{MSY} and their relation in a temporal series, should be used to estimate the level of pressure of the fishing activities.

  The estimations of the indicator F/F_{MSY} were obtained from the assessments described in previous sections for black hakes. The indicators have been calculated using the Biomass Dynamic model applied (BIODYN) as a standard model in the FAO/CECAF Working Groups. The assessments were attempted including the last data series available and taking into account the restrictions explained in section 1. The temporal series of F/F_{MSY} indicator are available from 2001 (Table 5.II).

Table 5.II. Values of F in relation to F_{MSY} (F/F_{MSY}), as estimated in the successive assessments of black hake Mauritanian stock, since 2002 to date. Years correspond to the last year of data used in the assessments.

Stock/Last Year	**2001**	**2002***	**2006**	**2008**
Merluccius spp.- Mauritanian	118%	-	114%	38%

*2002- The model did not fit the abundance index series

- ***Merluccius* spp. - Mauritanian *stock***: F/F_{MSY} indicator showed a significant decrease from values where F was not able to produce the MSY (118%) in 2001, to values of F (38%) well under the F that would produce the MSY (F_{MSY}) in 2008. The 2010 assessments (FAO, 2010, in press) with 2008 as the last year of data showed a clear recovering of the stock, that appeared to be under-exploited. At this point, it is worth reminding that the directed fleet has been progressively diminishing over the last decade and currently, only 2 vessels are operating in Mauritanian waters. Therefore, we think that the resource could allow an increase of F.

  However, these good results should be considered with caution, because the F estimations are only based on declared catches and are not taking into account the actual removals from the stock which should include undeclared and discarded by-catch..

  Note that for the 2004 assessment (FAO, 2006b), considering 2002 as the last year of data, the model BIODYN could not be fitted to the data set of abundance index. This problem was due to the lack of data on the hake by-catch of multiple fleets fishing in the Mauritanian EEZ Mauritanian. The joint review of the data series carried out in a IEO/IMROP Working Group *ad hoc* in 2005 (Fernández-Peralta, *et al*., 2007; in press) improved the quality of the data used for the following assessments, which showed good fits to data.

  Bearing in mind the above considerations, we think that this indicator could be useful for the management of Mauritanian black hake resource. However, efforts must be made to achieve better estimations of the actual level of by-catch (marketed and discarded) and discards, leading to more accurate F values.

  CECAF management recommendations are based on fishing effort and therefore, on the fishing mortality (F), whose accuracy relies on the improvement of the catch statistics. However, CECAF decisions are not mandatory and not binding on all member states.

2) **Reproductive capacity of the stock**

- **Primary indicator**: **Spawning Stock Biomass (SSB).** The SSB should be estimated from appropriate analytical assessments based on the analysis of catch at age or at length and ancillary information. As explained above, we are not able to estimate the SSB of black hake because no analytical models are currently used to assess the status of this resource in CECAF area. In spite of the series of Spanish-Mauritanian surveys carried out onboard the Spanish R/V Vizconde de Eza from 2007 to 2010, no direct estimation of the SSB could be done because biomass estimation data were not available. On the other hand, both the different depth ranges sampled in 2007 survey and the haul allocation divergences from 2008 to 2010 surveys make difficult to perform a proper analysis of the whole population (See Section 4). These considerations have also prevented obtaining a reliable size distribution of hake stocks, also required for the calculation of the maturity logistic curve. An unreliable estimate of the size at first maturity can lead to significant errors in the estimation of the SSB and wrong conclusions.

Moreover, these data are not available for a time series, as it is required to perform a reliable analysis.

- **Secondary indicators** (if analytical assessments yielding values for SSB are not available): **Biomass indices, which can be used if they can be obtained for the fraction of the population that is sexually mature.** The estimation of the fraction of the population sexually mature was not possible for hake species exploited in Mauritania, due to the problems in the estimation of size at first maturity for these species. Scientific surveys provided insufficient data on that issue (low catch of mature females and/or immatures) and did not enable the estimation of an accurate L_{50}. A recent L_{50}estimation was done gathering data from commercial trips and an experimental longline survey, covering the entire bathymetric distribution range of these hakes during the 2003-2004 spawning period. The difficulty of macroscopically assess a maturity stage and the discrepancies with previous studies indicated that the maturity estimation should be undertaken at a histological level for these species. Furthermore, a single L_{50} for both sexes and species is required for assessment purposes, but this parameter is not usually estimated.

  Therefore, neither primary nor secondary indicators could be used to estimate the reproductive capacity of the stocks of *Merluccius* spp. (***M. polli*** and ***M. senegalensis***) in Mauritanian waters. Moreover, estimations of these indicators are unlikely to be available at short-medium term, due to the backward state of the biological research in this country and the scarcity of data required for using analytical assessment methods.

3) **Population age and size distribution**

- **Primary indicators**: **Indicators based on the relative abundance of large fish**. The primary indicators have been estimated for the black hake stock, with data from the Spanish surveys carried out from 2007 to 2010. In spite of the doubtful representativeness of the length distributions based on the series of 4 Spanish-Mauritanian surveys, they have been used to give estimations of the primary indicators ii) and iii):

  i) Proportion of fish larger than the mean size of first sexual maturation- This indicator could not be estimated due to the lack of a reliable size at first maturity for this stock.

  ii) Mean maximum length across all species found in research vessel surveys. See Table 5.III.

  iii) 95% percentile of the fish length distribution observed in research vessel surveys. See Table 5.III.

Table 5.III. Mean maximum length (TL in cm) of *Merluccius* group and 95% percentile of *Merluccius polli* and *M. senegalensis* length distribution (TL in cm) estimated from research surveys carried out in Mauritanian waters in 2007, 2008, 2009 and 2010 (R/V Vizconde de Eza)(TL: Total Length, in cm).

***Merluccius spp*-Mauritania**	**2007***	**2008**	**2009**	**2010**
Mean Maximum TL	70	71	69	70
***Merluccius polli*-Mauritania**	**2007***	**2008**	**2009**	**2010**
95% percentile of the TL distribution	50	35	35	34
***Merluccius senegalensis*-Mauritania**	**2007***	**2008**	**2009**	**2010**
95% percentile of the TL distribution	64	65	53	58

*2007- Minimum sampled depth= 400 m

Table 5.III. shows primary indicators ii) and iii). Hake species were worked out separately and grouped as *Merluccius* spp. Indicator ii) was calculated for *Merluccius* group following the methodology of Piet *at al*. (2007). Mean maximum TL did not show any trend between 2007 and 2010, indicating a stability of the population.

Indicator iii) was calculated separately for each species: In *M. polli*, the 95% percentile of the length distribution decreased from 2007 to 2008 and remained constant the following years. In *M. senegalensis*, this indicator does not show any clear trend: it increased from 2007 to 2008, decreased the next year, and increased again in 2010 to 58 cm. These results are probably due to the different distribution areas of both species, and to the sampling scheme differences between the 4 considered surveys. In fact, the 2007 survey under sampled the bathymetrical distribution of hakes, as the minimum surveyed depth was 400 m (where were found the biggest specimens). In addition, the sampling was more intense in the deepest stratum, and sampled periods were coincident with strong recruitments. Therefore, the presented estimations of indicators ii) and iii) are neither reliable nor comparable between years.

- **Secondary indicator**: **Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation**. As explained above, size at first maturity data are unreliable or unknown for hake stocks in Mauritanian waters. Even if this secondary indicator was known, it will not be available over a period, as it is required for an analysis by expert judgement. This analysis, together with any other information on the biology of the species, should determine whether there is a high probability that the intrinsic genetic diversity of the stock will not be undermined.

5.3. - GUINEA-BISSAU

5.3.1. Guinea-Bissauan Management Measures

There are not current management measures specifically implemented for hake and other finfish in Guinea-Bissau, because these resources are mainly exploited as by-catch of cephalopod EU fleets. Then, the current management measures for these EU fisheries are the only ones affecting hake and finfish stocks. Such measures are included in the Fisheries Partnership Agreement between the EU and Guinea-Bissau[12], in accordance with Guinea-Bissauan law. They are very limited.

Current management measures for shrimps and cephalopod fisheries in Guinea-Bissau include: a) Management measures of access to the fisheries and b) Technical management measures.

a) Management measures of access to the fishery

As in Mauritania, the Guinea-Bissauan system of fishing effort control is based on the control of nominal effort, in terms of GRT. Thus, fishing opportunities established in the current Fishing Agreement allow 4400 GRT per year of freezer fin-fish and cephalopod trawlers, and 4400 GRT per year for freezer shrimp trawlers. These vessels operate with licences for 3-months, 6-months, or annual, under the fishing categories 1: "Freezer, fin-fish, and cephalopod trawlers" and fishing category 2: "Shrimp trawlers". The obtaining of a fishing licence for both fishing categories is subordinate to the payment of the fee for the period of validity of the licence and of the amount established in the Fishing Agreement. The access to the fishery to other foreign fleets is also based on the payment of fishing licences.

b) Technical management measures

The technical management measures currently implemented in the Guinea-Bissauan EEZ are quite reduced and are limited to those included in the EU-Guinea-Bissau fishing Agreement for each Category type, which are in accordance with Guinea-Bissau law. The only technical measures currently included are the following:

b.1. - Closed areas

Although there is not a closed area *sensu stricto*, the fishing zone of EU vessels in Guinea-Bissau is restricted to the area beyond 12 nautical miles from the coastline, including the Guinea-Bissau/Senegal joint management area, extending north to the azimuth 268°, for both finfish freezers , cephalopod trawlers, and shrimper trawlers.

b.2. - Gear types

Standard otter trawls, outriggers, and other selective gears are authorized for both fishing categories. In the case of all fishing gear, no methods or devices may be used to seek to obstruct the mesh of the nets or reduce their selective effect. However, in the interests of reducing wear or damage, protective aprons of netting or other material may be attached, but only to the underside of the codend of a bottom trawl. Such aprons must be attached only to the forward and lateral edges of the codend of the trawl. Protective devices may be used for the top of the trawl, but these must consist of a single section of net of the same material as the codend, with

[12] Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Republic of Guinea-Bissau for the period 16 June 2007 to 15 June 2011. (OJ L 342, 27.12.2007, p. 10-36)

the mesh measuring at least 300 mm when stretched out. Doubling of the codend's netting yarn, whether single or multiple is prohibited.

Minimum authorized mesh sizes are 70 mm for the finfish and cephalopod ffreezer trawlers and 40 mm for the shrimper trawlers.

b.3. - By-catch limits

The by-catch limits established in the Protocol of the Fishing Agreement are the following:

- 9% of crustaceans for cephalopod vessels.
- 50% of finfish and cephalopods for shrimper vessels.
- 9% of crustaceans and 9% cephalopods for finfish trawlers

Neither measures related to closed seasons nor minimum catch size exists, in the absence of such provisions enforced by Guinea-Bissauan laws. However, the fishing agreements contemplate the need of scientific advice for establishing the most appropriate recovery period for the target species.

5.3.2. Descriptor 3

"Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock".

For this descriptor, the three criteria for assessing progress towards GES and the indicators related to them are the following:

1) **Level of pressure of the fishing activity**

· **Primary indicator**: **Fishing mortality (F)**

No F indicator is available for hake and other finfish stocks because these resources have never been assessed in the FAO/CECAF Working Groups.

2) **Reproductive capacity of the stock**

· **Primary indicator**: **Spawning Stock Biomass (SSB).** Data for assessment of hake and other finfish were obtained by direct methods during the surveys carried out onboard the Spanish R/V Vizconde de Eza in 2002 and 2008, but they did not enable a direct estimation of the SSB because the required parameters (length composition in catch, length/weight relationship, parameters of the maturity logistic curve) could not obtained for our target species.

· **Secondary indicators** (if analytical assessments yielding values for SSB are not available): **Biomass indices, which can be used if they can be obtained for the fraction of the population that is sexually mature.** The estimation of the fraction of the population sexually mature was not possible for hake and other finfish exploited in Guinea-Bissau, due to the lack of general information about the size at first maturity of these species. Scientific surveys provided poor information on that issue.

Therefore, neither primary nor secondary indicators could be used to estimate the reproductive capacity of the stocks of hake and other finfish in Guinea-Bissauan waters. Furthermore, estimations of these indicators are unlikely to be available at short-medium term, due to the backward state of the biological research in this country and the scarcity of data required for using analytical assessment methods.

3) **Population age and size distribution**

- **Primary indicators**: **Indicators based on the relative abundance of large fish**.

i) Proportion of fish larger than the mean size of first sexual maturation. This indicator cannot be estimated for any species since there are not reliable estimations of size at first maturity in these surveys.

ii) Mean maximum length across all species found in research vessel surveys. See Table 5.IV.

iii) 95% percentile of the fish length distribution observed in research vessel surveys. See Table 5.IV.

Table 5.IV. Mean maximum length (TL in cm) estimated for the hake group, *Merluccius* spp (*Merluccius polli* and *Merluccius senegalensis),* the Sparidae group (*) and the Pleuronectiformes group (**) and the 95% percentile length distribution (TL in cm) of each species hake and of *Pagellus bellottii* and *Dentex maroccanus* obtained from research surveys carried out in waters off Guinea-Bissau in 2002 and 2008 (R/V Vizconde de Eza) (TL: Total Length).

Guinea-Bissau	Indicator	2002	2008
Merluccius spp.	Mean Maximum TL	57	53.6
Merluccius polli	95% percentile of the TL distribution	32	40
Merluccius senegalensis	95% percentile of the TL distribution	32.5	30
Sparidae *	Mean Maximum TL	26.3	26.7
Pagellus bellotii	95% percentile of the TL distribution	22.5	21.5
Dentex maroccanus	95% percentile of the TL distribution	13.5	21.5
Pleuronectiformes **	Mean Maximum TL	20.7	21.7

* Sparidae: *P. bellottii, Dentex maroccanus, D. angolensis, D. congoensis and Pagrus africanus.*

** Pleuronectiformes: *Cynoglossus canariensis, Dicologoglossa cuneata, D. hexophthalma, Microchirus frechkopi* and *M. variegatus.*

Merluccius spp. mean maximum length show a decrease in 2008. The different proportions and biomasses of each species obtained in 2002 and 2008 surveys may cause this reduction. *M. senegalensis* mean-sizes during Guinea-Bissau surveys were smaller than were those of *M. polli.* In 2002 survey, *M. senegalensis* catch was very low (2.5 t of total estimated biomass) compared to *M. polli* catch and consequently had almost no influence in mean maximum length estimation. The observed reduction in 2008 mean maximum length was due to a high catch of *M. senegalensis* (95 t of total estimated biomass) and to a significant decrease in that of *M. polli*.

This indicator (mean maximum length) showed a stability population in the Sparidae group, with similar values for both years. In Pleuronectiformes, we observe an increase from 2002 to 2008, which could indicate a good situation of this population.

M. senegalensis showed a 95% percentile of the TL distribution lower in 2008 than 2002, due to a higher proportion in the catch of small specimens in the 2008 survey. The contrary occurs for *M. polli*. Although its population structure was similar in both surveys, a much higher percentage of recruits was found in 2002.

P. bellottii showed a decrease of the third indicator in 2008, because more small specimens were caught in that survey, although the biomass was much higher. The increase between 2002 and 2008 observed for the 95% percentile of the TL distribution of *D. maroccanus* suggests a recovery of the population. This fact is supported by the increase in the sea bream biomass observed between the two surveys, of which this particular species is primarily responsible (525 t *D. maroccanus* biomass in 2002 and 9381 t in 2008).

- **Secondary indicator**: **Size at first sexual maturation, which may reflect the extent of undesirable genetic effects of exploitation**. As explained above, size at first maturity data are unreliable or unknown for most of the hake and other finfish stocks in Guinea-Bissauan waters. Even if this secondary indicator was known for the remaining species, it will not be available over a period, as it is required for an analysis by expert judgement. This analysis, together with any other information on the biology of the species, should determine whether there is a high probability that the intrinsic genetic diversity of the stock will not be undermined.

6. ASSESSMENT OF PRESENT MANAGEMENT MEASURES AGAINST THE MSY STRATEGY (CATCH LIMIT, EFFORT LIMIT, CLOSED SEASONS OR AREAS)

The Communication from the Commission to the Council and the European Parliament-Implementing sustainability in EU fisheries through maximum sustainable yield (MSY) (COM, 2006, 360 final) sets a new political orientation as regards fisheries management in the Community, in order to implement this approach, by accelerating its move towards a longer-term management system that focuses on obtaining the best from the productive potential of living marine resources. The Commission is developing long-terms plans with the aim of bringing all major fish stocks in EU waters to rates of fishing at which MSY can be achieves.

The MSY framework assumes that it is possible to reliably estimate the current fishing effort (F_{cur}) and the spawning stock biomass (SSB), and based on the assumed F, to infer appropriate management measures (e.g. TAC, effort restriction, MPAs) that will generate the desired F.

The concept of MSY is widely interpreted as the maximum long term average catch that can be achieved under prevailing conditions (including both the state of the ecosystem and size selectivity of the fishery). MSY is considered to be achieved by a fishing mortality (F_{MSY}) that produces a high long term average yield while the stock fluctuates around the stock size where production is at or close to the maximum. A strategy for achieving MSY can be expressed as a harvest control rule where F is a fixed target which may also be a function of stock size. This is the form of the International Council for the Exploration of the Sea (ICES) MSY framework (ICES, 2010b). The MSY framework is consistent with National and International policies and agreements, as well as the precautionary approach (ICES, 2010a).

ICES (2010b) suggested exploring the sensitivity of the estimates of candidates to the estimation of F_{MSY} proxies, to uncertainty and assumptions in the model parameters, and finally, where possible, to check the response of the stock to fishing at any proposed target in the long term (through simulation). With regard to the criteria for advice when there is no forecast, it was suggested that F advice in relation to putative F_{MSY} targets should be framed in terms of moving exploitation rates towards the target, rather than specifying a harvest in relation to the current stock status and/or expected short term development of the stock. Thus advice arising from circumstances where there is no short term forecast, has to be seen in the context of a "soft" evaluation of stock status relative to crudely estimated proxies. There are no new methods or techniques proposed in this report, and indeed the most basic equilibrium based methods are those used in the early years of fisheries science.

The EC consider that the F_{MSY} reference point can be used as a target, and that measurement error and uncertainty must be taken into account in its derivation. Averaged F expected to be realised through the implementation of a management plan, should be consistent with the F_{MSY} estimate for the stock and that projected average catches should be similar (ICES, 2010b).

Management measures of the hake and other demersal finfish fishing activities in Morocco, Mauritania and Guinea-Bissau were described in detail in section 5. In this section, their consistency with the MSY strategy explained above is analysed.

6.1. MOROCCO

Moroccan management measures include fishing effort control, and technical management measures such as closed areas, closed seasons, minimum catch size, gear types, and by-catch limits. Only the measures related to effort or catch limits, closed seasons and closed areas are analysed in relation to the MSY strategy:

- **Closed seasons:** A closed season is established for the EU demersal fleets operating in Morocco. The closed season established for the "Small-scale fishing/north" is from 15 March to 15 May. The fishing type "Demersal fishing" (targeting black hakes) is adjusted to the closed seasons established for cephalopods and only applicable to trawlers. As explained, this measure is used as an effort limitation but it is not specifically aimed at protecting black hake resources. In our opinion, the fact that these fleets have to stop during the resting period of the octopus (main cephalopod targeted species) has no sense, since the vessels fishing for black hake operate in deeper waters than cephalopod trawlers. As this measure is not protecting the hake spawners nor the recruits, we consider it is not in agreement with the general approach of the MSY strategy.

- **Closed areas:** The Moroccan authorities have established some marine protected areas (MAPs) in its waters (described in section 5), a measure in agreement with the general approach of the MSY strategy (COM, 2006), as well as closed areas. However, there is a dissimilarity between the closed areas for the domestic fleets (very limited) and the much wider closed areas specifically enforced for the EU fisheries (See section 5), that have been expanded in successive Agreements.

- **Catch limits:** For this fishery, the catch limits established in the Protocol of the Fishing Agreement between the EU and Morocco are those referring to by-catch limitations and are described in Section 5.1.1. These measures could be considered in agreement with the general approach of the MSY strategy of reducing the proportion of fish that are captured from the sea in order to allow them to grow more (COM, 2006).But, as far as we know there is no by-cacth regulation for the Moroccan fleets in these fisheries, which would be inconsistent with the MSY strategy.

- **Effort limit**: Fishing effort control is based on the use of fishing licences. Control of nominal effort is developed in terms of number of vessels by GRT category authorized for each fishing type. The access to the fisheries is managed through the purchase of fishing licences. Although CECAF recommendations are based on the fishing effort control, as far as we know, those recommendations are not followed by Moroccan authorities, as CECAF decisions are not mandatory and not binding on the coastal states. The use of $F_{MSY,}$ proposed by the EC as a target reference point (and recommended by other regional fishery bodies [RFBs] as ICES) is considered a logical and easy to implement measure for CECAF member states, as the assessments provide these values. For those stocks whose fishery data are inadequate to achieve reliable estimations of the stock size or projections of future stock size and catch, other approaches proposed by ICES (2010a) could be then applied by CECAF WGs.

European hake and sea bream – Moroccan stock:

- ***Merluccius merluccius***. The last assessment of *M. merluccius* (see section 3) showed an over-exploitation of the stock, with F much higher than F_{MSY}. This means that current management measures are not in agreement with the MSY strategy. The catch would reach MSY levels from 2013 onwards (Figure 3.1), if the management measures targeted an effort reduction of 40% (as recommended the projections made in the last FAO/CECAF WG, described in Section 3.1.1)
- ***Pagellus acarne.*** The results of the short-medium term projections in the last assessment were the same assuming a maintenance of the current exploitation level ("status quo") than diminishing in 10% the fishing effort of the last year of data (2008). Catch become stable in both projections for the following 5 years at sustainable and MSY levels, even though the abundance of the 5th projected year was well below the relative abundance index of MSY. In fact, the low reliability of the input data is probably the underlying cause of this inconsistency, because the assessment model was accepted despite a poor fit to data.

6.2. MAURITANIA

Mauritania has implemented similar management measures as Morocco. Here we only discuss the pertinence of effort or catch limitations, closed seasons, and closed areas in relation to the MSY strategy:

- **Closed seasons:** Since 2005, there is not a specific closed season for black hake fisheries in Mauritania, However, from 2005 onwards, the extension of the reserved area for the artisanal fishery, where trawling is prohibited, was enlarged (northward of 19º 15.6' N) during the closed seasons enforced for cephalopod trawlers (See section 5.2.1.b.1). This closed season for biological recovery was created as a conservation measure specifically aimed at protecting the octopus juveniles and/or spawners. Therefore, this measure is used as an effort limitation but does not protect the black hake resources, since the trawler fleet fishing for black hake operates in deeper waters than cephalopod trawlers do. As this measure is not protecting the hake spawners nor the recruits, we consider it is not in agreement with the general approach of the MSY strategy.

- **Closed areas**: Mautitanian authorities have specifically established a large closed area for black hake EU fishery, which has been expanded in successive Agreements (see section 5.2.1.b). In addition, there are also MPAs, such as the Banc d'Arguin National Park, which covers near 43% of the total non-trawlable area in the North zone (between Nouadhibou and Cape Timiris) and is closed to all type of motorized fishing vessels. These measures could be considered in agreement with the general approach of the MSY strategy of reducing the proportion of fish that are captured from the sea in order to allow them to grow more (COM, 2006).

- **Catch limits:** Mauritanian law only establish catch limitations referred to by-catch. Limitations of by-catch for black hake trawlers are: 25% fish and 0% cephalopods and crustaceans. By-catch longliners are limited to capture only 50% fish (other than black hake). No other catch limitations, such as total allowable catch (TACs), have been enforced by Mauritanian authorities. In the mid-1990s the Spanish fishing association of longliners voluntarily self-imposed to their vessels a maximum catch of 15 t per fishing trip.

These measures could be considered in agreement with the general approach of the MSY strategy of reducing the proportion of fish that are captured from the sea in order to allow them to grow more (COM, 2006).

- **Effort limit**: Fishing effort control is based on the use of fishing licences. Control of nominal effort is developed in terms of GRT for the industrial fleets, and in terms of vessel length overall for the artisanal fleet. The access to the fisheries is managed through the purchase of fishing licences.

  As already explained, CECAF, the EC and other RFBs (e.g. ICES) recommend the use of F_{MSY}, as a target reference point to limit the fishing effort and easy to implement in CECAF member states. For those stocks whose fishery data are inadequate to achieve reliable assessments and estimations of the stock size or projections of future stock size and catch, other approaches proposed by ICES (2010a) could be then applied by CECAF WGs.

  The projection presented in section 3, obtained from the assessments of the black hake Mauritanian stocks is analysed here to ascertain if the current effort restrictions (different F values) are in accordance with the MSY strategy:

Black hake - Mauritanian stock:

- ***Merluccius* spp.** The last projections of *Merluccius* spp were carried out with input data of the last FAO/CECAF assessment WG (FAO, 2010), when this stock was not fully-exploited. In that moment, abundance of hake was over the relative abundance index of MSY, but catch was below the catch level corresponding to the MSY level (Figures 3.5 and 3.6). The recommendation was not to increase the current fishing effort. We agree with this precautionary measure, since the model was not taking into account the actual total catch of black hake, which should consider not only the declared catches (input data for the model) but also the un declared by-catch and the discards. However, the information on the historical performance of the fishery and our knowledge of current data suggest that the black hake stock is actually under-exploited.

  The estimated effort level that would produce catches corresponding to a MSY has been calculated, showing that a fishing effort increase of 50% would produce the level of catch of the MSY (Figure 6.1). This indicates that the Mauritanian fishing effort limitations are not in accordance with the MSY strategy because it would be possible to increase the effort. Nevertheless, we think that a maximum increase of 20% of the fishing effort would be a good precautionary management measure, taking into account our lack of good knowledge of black hake's eco-biology and the interannual abundance variations of the resource shown to be partially dependent on environmental conditions (evidenced NAO index influence).

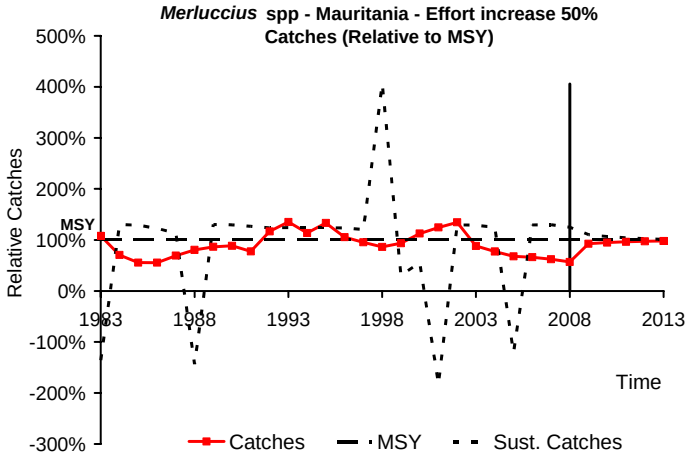

Figure 6.1.-Short-and medium-term projections of *Merluccius* spp. (*Merluccius polli* and *M. senegalensis*) catch in Mauritania, increasing the effort level of 2008 in 50%.

6.3. GUINEA-BISSAU

Guinea-Bissau management measures are very limited (see review in section 5) and are basically those included in the EU-Guinea-Bissau fishing agreement. Moreover, the few measures in force are applicable to most major fisheries in Guinean Bisauan waters (cephalopods and shrimps) whose target species are not finfish, although they can punctually achieve large quantities of finfish by-catch. We have also certain doubts about the existence of management measures for the non-EU foreign fleets, which, as far as we know, are quite unregulated even though they catch significant volumes of hakes and other finfish.

The measures included in the EU-Guinea-Bissau fishing agreement are basically referred to the control of nominal effort, in terms of GRT, through the purchase of fishing licences. Technical measures only concern fishing gears and by-catch limits.

The main finfish resources (hake, sea bream and flatfish) in Guinea-Bissau have never been assessed, since no industrial fishery has been targeting them officially. Though, we have recently been informed that these finfish resources have been heavily exploited. No projections were attempted due to the absence of assessments for resources with no regulation measures.

7. ASSESSMENT OF THE RELATIVE IMPACT OF THE EU DEMERSAL FISHING FLEETS CONSIDERING THE OVERALL FISHING ACTIVITY IN THE AREA OF THE FPA

In order to assess the relative impact of the EU hake fleets in relation to the overall fishing activities in Morocco, Mauritania and Guinea-Bissau, a compilation of data from all fleets operating in these EEZs is needed. Information from fleets operating in Morocco and Mauritania have been obtained from the last FAO/CECAF WG on demersal assessments in Agadir (FAO, 2010) and information from fleets operating in Guinea-Bissauan fishing grounds come from the first Joint Scientific Committee UE-Bissau (Bissau, October 2010) (unpublished).

7.1. MOROCCO

7.1.1 European hake fishery

There are no EU fleets targeting this resource, and therefore the relative impact on the resources is 100% attributed to Moroccan fleets. Nevertheless, the real impact is unknown because of the unknown catches of longliners operating as joint ventures, not reported to the last FAO/CECAF WG on assessment of demersal resources-North region (FAO, 2010). We suspect that these longliners have fished significant amounts of European hake over the last decade.

7.1.2 Black hake fishery

This fishery was inactive from 2000 to 2003, when Moroccan coastal fleet began to declare hake catches. Nevertheless, as hake was part of the by-catch no data of fleet real effort were available. In 2007, two Spanish trawlers began their fishing activities in the area within the frame of the new agreement, although one of them left in 2008. We compare here the catch of this fleet since the renewal of the agreement (2007) with the catch of previous years, provided to the last FAO/CECAF WG on assessment of demersal resources-North region (FAO, 2010) (Table 7.I).

Table 7.I. Percentages of *Merluccius* spp. catch due to black hake Spanish fleet and Moroccan coastal fleet (non-directed) in Moroccan waters, and total catch (tons, t) of both fleets, from 2004 to 2008.

FLEET	2004	2005	2006	2007	2008
Spanish black hake trawl	-	-	-	23	47
Moroccan coastal fleet	100	100	100	77	53
Total Catch (t)	1711	1179	793	727	1477

In the first year of the agreement (2007) the Spanish fleet did not operate the whole year, a fact that decreases its proportion in the total catch. The first representative year was 2008, when Spanish and Moroccan fully effective fleets operated. We must mention that the Moroccan vessels non targeting hake had presumably a greater impact on recruits than had the rest of vessels.

7.1.3. Sparidae (sea breams) fishery

As already explained the information on sea breams catch is limited and coming mainly from freezer cephalopod trawl and Moroccan coastal fleets. The catch of the artisanal fleet is often unrecorded, but some information of is given in Figure 7.1. Moroccan artisanal fleet is composed of a great number of boats spotted along the entire Atlantic Moroccan coastline. Consequently, landing data are easily missed and unrecorded. The main landing port of the Spanish artisanal fleet (operating south of 30º 40' N) is located in the Canary Islands. The catch of this Spanish artisanal fleet have been very low over the last years under (Table 7.II, with data from the last FAO/CECAF WG on assessment of demersal resources-North region [FAO, 2010]).

Table 7.II. Percentages of Sparidae catch due to Moroccan and Spanish fleet in Moroccan waters and total catch (tons, t) of both fleets, from 2004 to 2008.

FLEET	2004	2005	2006	2007	2008
Moroccan freezer cephalopod	74.2	71.6	61.2	48.0	47.7
Moroccan coastal fleet*	24.4	27.0	36.9	51.4	51.0
Moroccan artisanal fleet	1.4	1.4	1.9	0.4	0.8
Spanish artisanal fleet	0.0	0.0	0.0	0.2	0.5
Total catch (t)	8301	10769	7895	8631	7633

* Including catch of directed (longline) and non-directed (trawl) coastal fleets.

The catch of the main marketed sea breams is represented in Figure 7.1, showing that the highest volumes correspond to the by-catch of Moroccan fleets targeting other species, such as cephalopods, or are due to coastal trawlers. The Moroccan coastal longliners (whose catches are included in the coastal fleet data with the coastal trawlers) and the artisanal vessels are the only fleets targeting these species, but their impact on the resources is much lower than that of the non directed fleets (Moroccan freezer cephalopod trawlers and Moroccan coastal trawlers. Moreover, the Spanish artisanal fleet has a negligible impact on the resource (Table 7.II).

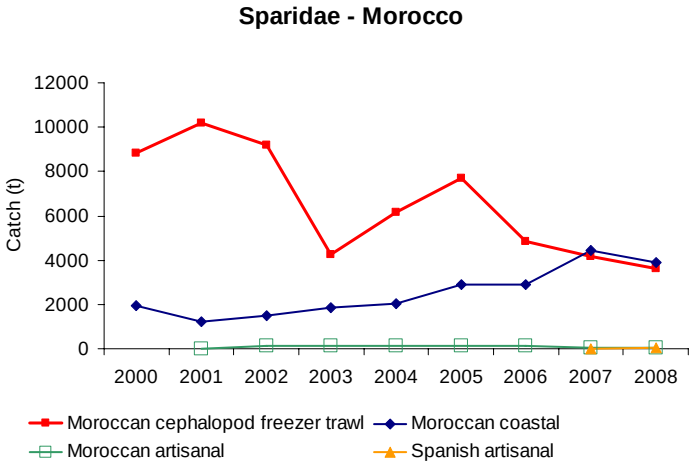

Figure 7.1. Evolution of catch (tons, t) of Sparidae from fleets operating in Moroccan waters from 2000 to 2008. (Sparidae species: *Pagellus acarne, P. bellottii, P. erythrinus, D. macrophthalmus, Sparus auriga,* and *S. aurata)*

The only data series of fishing effort provided to the FAO/CECAF WG corresponded to the Spanish artisanal fleet. In any case, we can not compare this data because they are directed and non-directed fleets.

Figure 7.1 shows an important decrease in the catch due to Moroccan cephalopod freezer trawlers in the last years of the analysed series, which is the opposite of the increasing trend of the Moroccan coastal fleet (Figure 7.1). For the cephalopod fleet, the decrease may be related to the extension of the closed season for the cephalopod fleet from 2 to 4 months (FAO, 2010). Furthermore, by species we observe a catch decrease of deep-sea (250-500 m) Sparidae, especially those reaching big sizes (*Pagellus* spp. and *Dentex macrophthalmus*) (Figure 7.2.a). On the contrary, this fleet increased the catch of other sea breams, such as *Sparus* spp. (*S. auriga* and *S. aurata*) living in shallow waters around 30 m depth (maximum depth range of 170 m) (Figure 7.2. a). Therefore, this change in the fishing strategy and/or in the abundance of the resources can be added to the catch reduction attributable to the extension of the closed season.

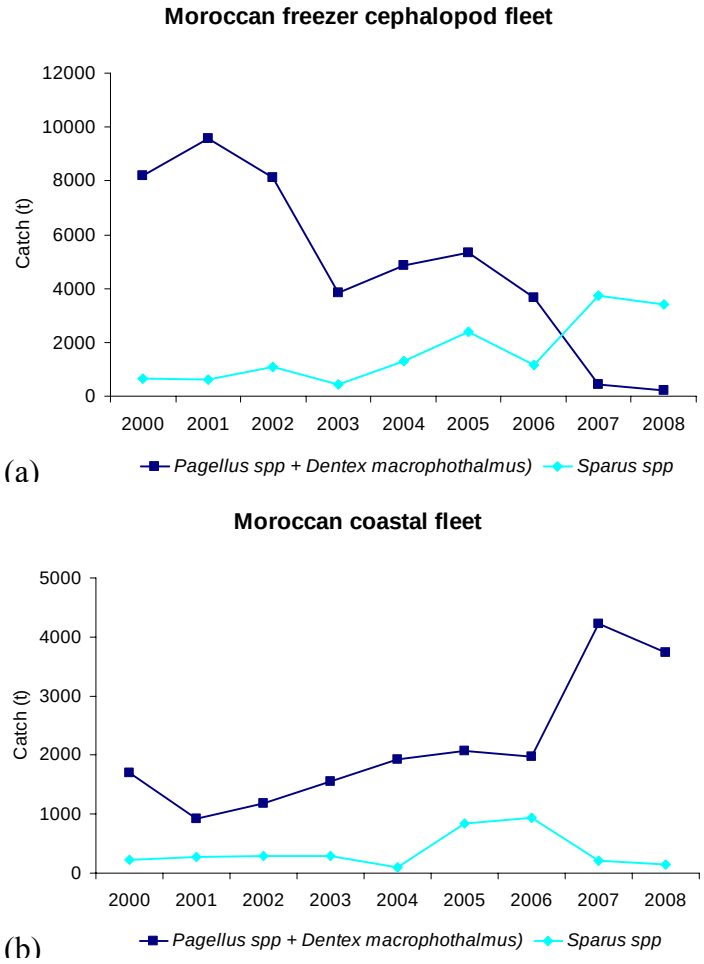

Figure 7.2. Evolution of catch (tons, t) of Sparidae group (*Pagellus* spp.: *P. acarne*, *P. bellottii* and *P. erythrinus*, and *D. macrophthalmus*) and *Sparus* spp. (*S. auriga* and *S. aurata*) from Moroccan freezer cephalopod (a) and coastal (b) fleets operating in Moroccan waters from 2000 to 2008.

The coastal fleet shows an opposite trend, with a reduction of *Sparus* spp. catch and an increased catch of deep-sea Sparidae (Figure 7.2 b). This suggests another change in the fishing strategy of the coastal fleet, probably associated to the one of the freezer cephalopod fleet.

Virtually almost all the impact of the fishery on these resources is attributed to the Moroccan fleets (cephalopod freezer trawl and coastal fleets). These Moroccan fleets are harvesting both the recruit and the reproductive fractions of the sea bream populations, as they exploit a wide bathymetric range. In addition, as the discards produced by both fleets are not recorded, the impact of these two Moroccan fleets over the sea bream resources must be even higher than recorded.

7.1.4. Other finfish and elasmobranchs

Only the catch data from the Spanish artisanal fleet are available. This fleet, currently operating north of 34º18'N, as established in the fishing agreement for the period 2007-2010. As already explained in previous sections, Trichiuridae is the main target group (84% of catch), followed by *P. bogaraveo* (9%). Unfortunately, catch data from Moroccan fleets are not available and therefore, the impact of the EU (Spanish) fleet cannot be estimated.

As reported to the last Joint Scientific Committee EU-Morocco (Anonymous, 2009), Moroccan longliners (probably most of them operating as joint ventures) were catching deep-sea sharks of vulnerable species included in the IUCN lists, such as *Centrophorus* spp., *Centroscymnus coelolepis*, and *Deania* spp. There was speculation about the Spanish artisanal fleet also fishing these species in North Morocco, but the IEO (Spanish Institute of Oceanography), through its information and sampling network has verified that this Spanish fleet is not landing any of these vulnerable shark species in the Canary Islands ports.

The Spanish trawler fleet targeting black hakes captures Elasmobranchii species (including rays) as by-catch (See Section 1.1.3). As far as we know, this fleet, which operates south of 29º N is probably the one exerting the highest impact on this group. However, this impact is not very high, as there is only 1 Spanish vessel operating in the area, whose landings averaged (2008-2010) 120 kg of sharks and 275 kg of rays per fishing trip. In any case, the real impact of the EU (Spanish) fleet cannot be reliably estimated, as we have no information of the catch achieved by the Moroccan black hake fleet, which may be also harvesting this group.

7.2. MAURITANIA

7.2.1. Black hake fishery

Merluccius spp.

Spanish trawl wet-fleet targeting black hake has been the most important in Mauritanian waters in terms of catch and effort, compared to the rest of the fleets operating in the area (Table 7.III). The data analysed here were provided to the last FAO/CECAF WG on assessment of demersal resources-North region (FAO, 2010).

Over the last decade, in addition to the Spanish fleet only some Portuguese and, occasionally, Greek vessels have been fishing black hake. In absence of accurate information of other EU fleets, the Mauritanian fisheries research institute (IMPROP) has provided the fishery statistics for these non-Spanish EU fleets (included as "Other nationalities trawl"). The Spanish fishery data are provided by the IEO, and Mauritanian catches and by-catch information are also Mauritanian fishery statistics.

Before 2006, some Spanish freezer trawlers targeted for a decade other demersal species but they actually fished large quantities of black hake recorded as by-catch. The black hake longliners are also directed to the pomfret (*Brama brama*), and have been fishing in these waters for less than 20 years. Many fleet are fishing black hake as by-catch, being the pelagic, cephalopod and shrimper fleets the most important ones. Therefore, the Spanish wet-trawl fleet ("Spanish black hake trawl" in the table 7.III) is the genuine fleet that has been targeting black hake over 50 years. Thus, we can consider the Spanish wet-trawl fleet is representative of the EU fleet, together with the Spanish longliners. Despite all the mentioned fleets, there must still be a certain amount of unrecorded catches, as well as a significant discarded by-catch.

Table 7.III. Percentages of *Merluccius spp.* catch and effort due to black hake directed and other fleets (non-directed) in Mauritanian waters and total catch (tons, t) and effort (fishing days, f.d.) of all fleets, from 2004 to 2008.

Percentage Catch					
FLEET	**2004**	**2005**	**2006**	**2007**	**2008**
Spanish black hake trawl	65	77	68	76	84
Spanish black hake longline	5	2	1	4	3
Mauritanian black hake trawl	5	2	1	0	0
Other nationalities trawl	4	1	8	6	0
Other fleets (by-catch)	21	18	22	14	12
Total Catch (t)	9136	8005	7818	7368	6753
Percentages Effort					
FLEET	**2004**	**2005**	**2006**	**2007**	**2008**
Spanish black hake trawl	62	80	84	84	90
Spanish black hake longline	15	6	3	9	9
Mauritanian black hake trawl	10	9	4	0	0
Other nationalities trawl	14	5	10	7	1
Other fleets (by-catch)	-	-	-	-	-
Total effort (f.d.)	3285	2377	2461	2645	1960

The relative importance in percentage of catch and effort of the Spanish hake trawl fleet has increased gradually from 2004 to 2008, particularly because the other fleets have moved out, (as Mauritanian and non-Spanish UE ones) and also because the declared by-catch has decreased. In addition, the reliability of the recorded by-catch record is totally unknown. Nevertheless, the high percentages of declared by-catch are indicative of the high fishing pressure exerted over the stock by non-directed fleets (Figure 7.3.a), where the UE cephalopod trawlers (mainly Spanish)stands out, followed by a number of vessels from Portugal, Italy, Greece, and Mauritania, as well as some large pelagic vessels (mainly Russian). Black hakes are also a by-catch of the EU shrimpers, though to a lesser extent. It is very difficult to calculate separately all these by-catch efforts and are not comparable with the rest of fleets (Figure 7.3.b).

As explained, the Spanish effort has decreases dramatically in 2010 from 6 to 2 vessels in that year, an only 1 in 2011. Even ignoring its annual by-catch, the current fishing pressure of non-directed fleets on the young hake population might be much more serious than the pressure of the Spanish directed black hake trawlers.

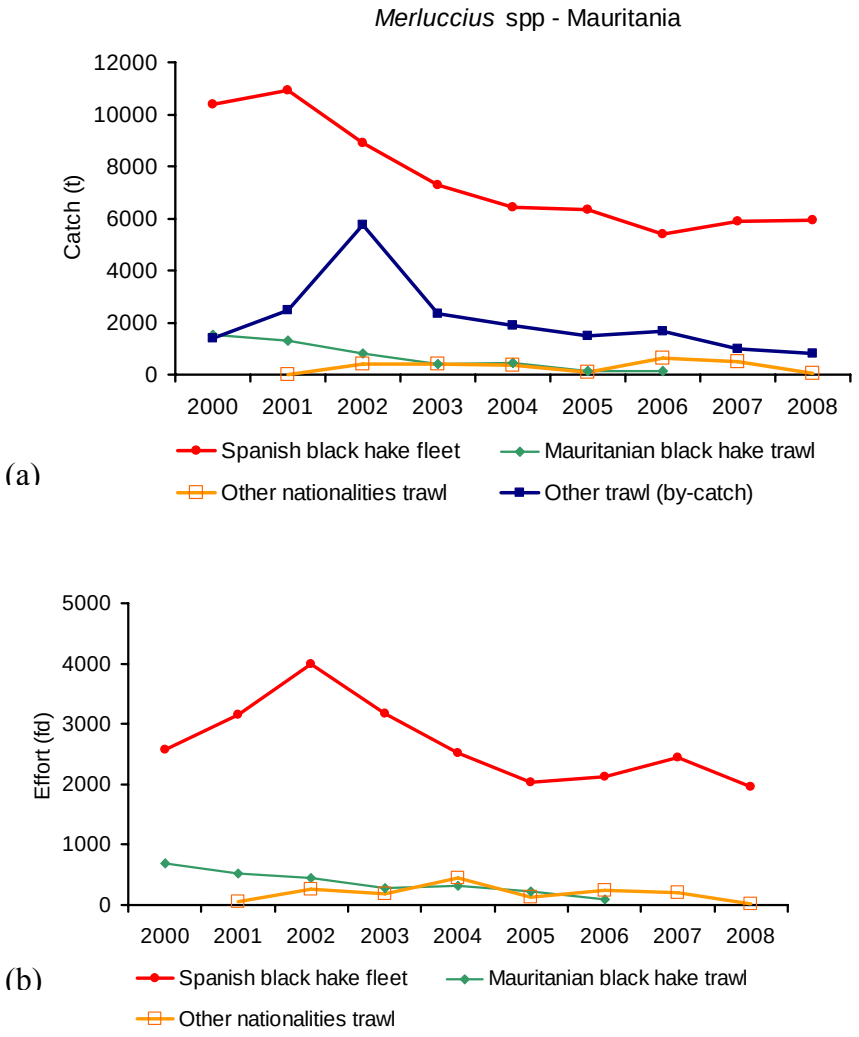

Figure 7.3. Evolution of catch (tons, t) and effort (fishing days) of *Merluccius* spp. from fleets operating in Mauritanian waters from 2000 to 2008.

7.3. GUINEA-BISSAU

A major issue when estimating the impact of the fleets on the fishing resources is the high level of illegal, unreported and unregulated fishing (IUU) occurring in Guinea-Bissau (MRAG, 2010).

7.3.1. Hake resources

Merluccius polli

There are not specific fisheries targeting hake in waters off Guinea-Bissau, although *M. polli* is a significant by-catch species of several fisheries. Therefore, there are important limitations to estimate the real impact that EU fleets may have on this stock, as we ignore the real effort exerted on it. In addition, only recent data (2007-2009) of hake as by-catch are available, and we do not have longer historic fishery information to evaluate the general fishing impact on *M. polli*.

To have an approximate idea of the situation, we have compared the by-catch values reported by the industrial (all foreign) fleets from 2007 to 2009 (Table 7.IV).

With the reported data, the EU (mainly Spanish) cephalopod fleet seems the one having the highest impact on this resource. However, the proportion of by-catch of *M. polli* has decreased in 2009 for the Spanish fleet, while it has increased for the "Other nationalities" fleets. Furthermore, as Spanish catch values have been reduced in 2009 (and also in 2010), we can consider that the current impact of the Spanish cephalopod fleet on the black hake is negligible.

Table 7.IV. Percentages of *Merluccius polli* by-catch of European and other foreign fleets in Guinean Bissauan waters, and total catch (tons, t) of all fleets, from 2007 to 2009.

FLEET	2007	2008	2009
EU freezer Cephalopod	99	96	79
EU freezer Shrimp	1	0	1
Chinese fleet	0	0	2
Other Nationalities	0	4	18
Total Catch (t)	1236	1306	56

7.3.2. Flatfish resources

Pleuronectiformes

This wide group of flatfishes, grouped as "Pleuronectiformes", accounts for a significant percentage of the by-catch achieved by several fleets operating in waters off Guinea-Bissau. Table 7 contains the by-catch proportions of Pleuronectiformes of the industrial fleet, but no data are available for the artisanal fleet. Thus, the calculations of the EU impact could be overestimated.

In general, percentages of the reported by-catch of flatfish are variable from one year to another. In 2007, the EU (mainly Spanish) cephalopod fleet seems the one having the highest impact on this group of species, but in the following years, it was the Chinese fleet (in 2008) and other foreign fleets (in 2009) recording the highest proportions of flatfish as by-catch (Table 7.V). Therefore, in 2009 the impact of the EU fleet (mainly Spanish) was low compared with the other industrial fleets.

In the last year, Guinea-Bissauan scientists have made valuable efforts to improve the quality of their industrial fishery data-base, even though some inconsistencies and incongruences still remain. In addition, as said above there is no information about the artisanal fleet that may have an unknown impact on this group of species.

Table 7.V. Percentages of Pleuronectiformes by-catch of European and other foreign fleets in Guinean Bissauan waters and total catch (tons, t) of all fleets, during from 2007 to 2009.

FLEET	2007	2008	2009
EU cephalopod freezer	70	34	21
EU shrimp freezer	8	7	10
EU finfish	0	0	2
Chinese fleet	10	46	29
Other Nationalities	11	12	38
Total Catch (t)	1296	1252	2018

7.3.2. Sparidae resources

The industrial fleets operating in the area report a very low catch of sea breams. This fact, together with the lack of information on the artisanal fleet, makes impossible to assess the impact of both fleets on this resource.

8. ARE THE ANALYSIS AND METHODS APPLIED TO PROVIDE SCIENTIFIC ADVICE ADEQUATE TO THE AVAILABLE BIOLOGICAL AND FISHERY DATA/INFORMATION?

The West African stocks under the scope of this report are exploited by the coastal countries as well as by foreign fleets. This fact advises the establishment of a scientific cooperation framework, over-arching cooperative actions, such as the assessment of the exploited resources. This scientific framework is provided by the Committee for the Eastern Central Atlantic Fishery (CECAF). There are five CECAF permanent Working Groups (artisanal fisheries, small pelagic resources [subgroups north and south], demersal resources [subgroups north and south]), created as CECAF advisory bodies. Moroccan and Mauritanian hake and other finfish stocks are assessed in the Working Groups (WGs) on the Assessment of Demersal resources-Subgroup North, covering the main demersal stocks exploited from Morocco to Senegal-The Gambia. Guinea-Bissauan stocks are supposed to be assessed in the Working Groups (WGs) on the Assessment of Demersal resources-Subgroup South (which include the rest of the CECAF countries, from Guinea-Bissau to Angola) although the lack of information concerning the stocks considered in this report have not allowed any assessment yet. CECAF aimed at celebrating these WGs on an annual basis, but unfortunately and due to economical reasons, the WGs are held with no scheduled periodicity. The main objectives of these WGs are assessing the status of the resources and providing scientific advice to ensure an optimal and sustainable use of the resources.

The assessment process followed in the WGs covers four major steps (Balguerías, 2009):

1) Gathering of basic information from the fisheries. The compilation of information from both artisanal and industrial fisheries is under the responsibility of flagging countries, which are obliged to submit periodical data (usually on an annual basis) about vessels characteristics, gears, fishing strategies, fishing effort, and catch, both by species and statistical divisions.

2) Biological and population studies of the most important species and stocks. Research institutions from countries belonging to the CECAF are requested to conduct national sampling programmes to estimate biological and population parameters needed for stock assessment. These studies mainly refer to stock identification, growth, reproduction, alimentation, length structure, and natural mortality of the most important species in their respective fisheries.

3) Estimation of abundance indices by fishery independent methods. This task is also under the responsibility of national research institutions. Many of the CECAF countries, particularly those from the North region conduct periodical surveys to obtain abundance indices of the main fish resources in their respective EEZs. This regular activity is sometimes complemented by occasional surveys carried out by foreign countries.

4) Stock assessment by indirect methods. This task is always carried out during the regular meetings of the CECAF permanent WGs. Assessment methods applied have evolved over the years. Lately, they have converged to a standard methodology based on dynamic production models. The Schaefer dynamic production model and its fitting are implemented in a MS Excel spreadsheet under the BIODYN software (Punt and Hilborn, 1996; Barros, 2007). This is very simple and friendly software, containing data handling, analysis, diagnostics, and short-medium term projection routines developed for general use at all working groups. Also, analytical methods are occasionally applied to assess specific stocks.

Problems associated to the assessment process

1) Data gathering

The data gathering is one of the most crucial steps in the assessment process. The nature and the quality of this information determine the assessment methods to be applied and more important, the reliability of the results. Regarding this question, several constraints have been identified (Balguerías, 2009). They mainly refer to the geographical and fleet coverage and the information updating.

- Some of the CECAF countries do not have an appropriate statistical network and/or administrative services able to collect the needed information. This is the case for most of the southern countries in the region, whose statistics are inexistent or are rough estimates based on occasional interviews made over the years.

  The situation for industrial fisheries is generally good, since there is a compulsory standard declaration system (logbooks) in force in most of the countries, which permits disposing of quite reliable estimates of their respective production, at least for the target species. This is the case of Morocco and Mauritania, where the industrial fishery information is compiled through logbooks and is relatively well updated. However, certain disparities have been found in the data provided to different meetings, fact that indicates that efforts should be made to improve the Mauritanian and Moroccan databases. However, Guinea-Bissau has never provided fishery information regarding hake or other finfish stocks to CECAF WGs, even if we must acknowledge the improvement on the compilation of industrial fishery information that could be noticed during the 2nd Meeting of the Scientific Committee between the Republic of Guinea-Bissau and the European Union (FAO, 2010).

  Major difficulties arise in artisanal fisheries where the establishment of reliable and long lasting information systems has failed in many cases. Morocco and Mauritania are making efforts to improve the compilation of artisanal fishery information. However, there is an absolute lack of information about the artisanal fishery in Guinea-Bissau, which is a very important fishing sector in the country.

- Another problem attached to data gathering in the CECAF region is the **updating of the time series**. The statistics preparation is a long time consuming work and the information generally available for assessments at the time of the working groups do not contain data from the most recent fishing season. That is, stocks are being assessed with data series already one or more years old and therefore results do not reflect their current situation but the situation of the year/s preceding the assessment.

- **Illegal, unreported and unregulated (IUU) fisheries** are another serious source of uncertainty when estimating actual catches in the CECAF region. Illegal fishing is known to be a particular problem in the South area of CECAF (Central West Africa). In fact, Central West Africa has been highlighted as the area with the highest level of IUU fishing in the world.

  Guinea-Bissau is one of the countries more affected by this fishing, with an estimated level of IUU of 41% of the legal catch (MRAG, 2005). In Guinea-Bissau, both the artisanal and the industrial fleets (national and foreign) are involved in numerous IUU fishing activities. Problems related to the industrial fleet include, among others, fishing vessels transhipping their catch to larger freezer vessels that transport the fish products to be sold in distant markets without being reported (MRAG, 2010). Regarding the artisanal vessels, the illegal activity having the greatest impact is those of a large number of highly efficient artisanal fishing boats coming from neighbouring countries, particularly Senegal. The majority of this illegal artisanal catch is landed in Senegal and exported to major markets. It has also been reported that these

fishermen are engaged in transhipping their most valuable catch across to foreign trawlers in exchange for food items, fuel and money (MRAG; 2010). In addition to the economic losses to Guinea-Bissauan revenues, this IUU involves a great underestimation of catch in this country.

On the contrary, the overall rates of illegal activity in Morocco and Mauritania are relatively low. The estimated level of IUU fishing were 7,5% and 9% of legal catch, in Morocco and Mauritania, respectively (MRAG, 2005). We think these estimates, although they are not totally real, can used to compare the situation presented by each country in this regard. This is mainly due to a greater capacity of monitoring, control and surveillance (MCS) of these countries, which is practically inexistent in Guinea-Bissau. Some infractions related to IUU in the Mauritanian industrial sector include false nationalization, whereby foreign vessels registered as Mauritanian (thus qualifying for the reduced national licence fees for fishing) do-not complete the re-registration and reflagging process. More than 150 Chinese vessels have committed in recent years this type of infraction.

The main IUU activities related to the artisanal fleet in Mauritania include fictitious or lack of registration, unlicensed fishing or transhipment of catches at sea. In the Mauritanian-Senegal fishing agreement, Senegalese artisanal vessels should land 15% of their catch in Mauritania, but it is a common practice to land most of these catches in Senegal (MRAG, 2010). This may affect to species as flatfish and sparids, which are commonly fished by the artisanal fleet. Discards and by-catch of both legal and illegal fisheries constitutes a great part of the unreported fishing. The IUU fishing has an impact on data quality for stock assessment, which may lead to management decisions being based on incorrect stock assessment estimates, as those resulting of false catch declarations.

2) Estimation of population and biological parameters

The parameters used for stock assessment would require the existence of long term sampling programmes at each of the countries in the region. Most of these countries do have neither the required human and economic means nor the infrastructures to maintain such activity. The review of biological information compiled in section 4 indicates that, with the exception of the black hake of Mauritanian waters, there is a generalized lack of knowledge of population and biological information for the hake and other finfish stocks in Morocco and Guinea-Bissau, needed for stock assessment.

3) Surveys

The surveys carried out periodically to obtain fishery independent abundance indices are restricted to the northern countries of the CECAF region (i.e. Morocco, Mauritania and Senegal). Some of the series are quite long, starting already in the 1970s or in the 1980s with, in some cases, two or more cruises per year. Nevertheless, many of these surveys had stock oriented objectives: collecting information of a single target species (octopus, hake, sardine, sardinelles, etc.) and paying limited attention (or no attention at all) to other species in the ecosystem. Furthermore, sampling methodologies (geographical coverage, seasons, research vessel, fishing gears, etc.) have changed across the years making sometimes difficult any kind of comparisons on the estimated abundance indices and parameters from species. This situation is reflected in the high variability of the calculated values for many of the species and eventually in their contradiction with estimates obtained from other data sources (i.e. CPUE from fisheries) (Balguerías, 2009).

4) Stock assessments:

- The first difficulty encountered by the working groups refers to the accurate **identification of biological stocks**. In fact, the absence of scientific evidences enabling the identification of hake and other demersal finfish stocks in West African waters determines that assessment should be make considering the stocks within the geographic boundaries of each country. Furthermore both species are caught and landed together and therefore, they appeared mixed in fishery statistics. This is the case of black hakes, which are assessed as *Merluccius* spp. Studies have been carried out by the IEO during the last years, with the aim of a better knowledge on the biology of both black hake species, based on their fecundity and growth, and their proportion in catches. The last objective of these studies is the exploration of the possibilities of assessment by analytical models, together with the comparison of both analytical models and production models results, in order to be able to validate the last ones.
- **Catch and effort** are the general information common to the majority of the fisheries. The different working groups agreed on using this kind of information as an interim solution for the assessment of the regional stocks by using surplus production models with the commitment of evolving to more appropriate methodologies as new biological and population data were becoming available. This decision permitted the development of a standard software (BIODYN) based on dynamic production models, that has since then being used in all permanent CECAF WGs for stock assessment.
- However, the model has some problems (Balguerías, 2009). The main recognized problem associated to this model is that it is not adapted to the life cycle of many of the species, which is not the case in hake and other finfish. The unfeasibility of the current assessment methodology for calculating variability around estimates hinders any advice on the accuracy of the diagnostics on the actual state of the stocks, as well as on the risks eventually associated with the introduction of different management options. This uncertainty around the results of the assessments explains why most of the management advices provided by the CECAF working groups are rather poor and imprecise.

Therefore, for a better assessment process it is important:

- To identify the biological boundaries of the stocks.
- To establish a monitoring routine of basic information from fisheries concurring on these selected stocks
- To continue or to initiate continuous biological studies on selected species.
- To analyse existing survey data to propose standard methodologies to be applied in the region.
- To continue developing or adapting assessment models and methodologies better adapted to the biological characteristics of the species.
- To assure the periodic celebration of the meetings of the permanent assessment working groups.

In conclusion, there are several problems related to the assessment of the Moroccan, Mauritanian and Guinea-Bissauans stocks, which are common to most of the stocks in the CECAF area. They include:

- Poor fishing data (uncompleted, irregular or not updated statistics; unreported by-catch and discards and illegal, unregulated and unreported catches).
- Scarcity of available biological information about these species in the area makes that stocks have to be defined arbitrarily, for assessment purposes, within the geographical limits of the countries where they are exploited. As a consequence of that, many attempted assessments have to be rejected because of poor data and/or the uncertainty of the stock identity.

The lack of basic biological information and the poor data from the fisheries does not allow the use of appropriate specific assessments models. Because of this, a standard assessment methodology has being applied, which is based on a dynamic production model. Although this model has certain advantages, its application is not adapted to the lifespan cycle of many of the assessed species, which mainly are short living species.

Besides, the climatic conditions affecting the variability of the species, as it occurs with the NAO index, which have seen that affect to abundance hakes in the area, as explained in the document (See section 4). It is likely that enhanced and persistent upwelling conditions, with NAO+ could be favourable for European hake along its southern distribution limit, but produces the opposite effect on black hake abundance because those species have preferences and migratory cycles that are associated with warmer waters than the European hake (Meiners, 2007; Meiners *et al*., 2010).There fore, climatic conditions should be analyzed to set the basis for the development of predictive models which might contribute to a better management of the stocks.

REFERENCES

Anonymous, 1991. Rapport du Groupe de Travail Maroc-CEE sur l'evaluation des stocks de Sparides et autres demersaux peuplant les fonds chalutables et non chalutables entre 21ºN et 36ºN. Casablanca, 26-30 Novembre 1991 (mimeo).

Anonymous, 2009. Proces Verbal de la 2ème Reunion Comite Scientifique Conjoint Maroc-Communaute Europeenne: 66 pp. Bruxelles, du 17 au 19 Mars 2009.

Anonymous, 2010. Report of the First Meeting of the Scientific Committee between the Republic of Guinea-Bissau and the European Union. 6-8 September 2010. Guinea-Bissau.

Arístegui, J., Gasol, J.M., Duarte, C. M. and Herndl, G. J., 2009. Microbial oceanography of the dark ocean'spelagic realm. *Limnology and Oceanography* 54, 1501–1529.

ATLANTNIRO. 1978. Les merlus (*Merluccius spp.*) de la côte nord-ouest de l'Afrique. In: Report of the ad hoc working group on hakes (*Merluccius merluccius, M. senegalensis, M. cadenati*) in the northern zone of CECAF. IEO, Sta. Cruz de Tenerife, Canary Islands, Spain. 5-9 June 1978. *FAO CECAF/ECAF Ser.78/9* App. 6:43-64,

Balguerías, E., 1985. Actividad de la flota artesanal canaria que faenó en la costa noroccidental africana de 1975 a 1982. Simposio Internacional sobre las áreas de afloramiento más importantes del oeste africano (Cabo Blanco y Benguela). BAS, C., MARGALEF, R., RUBIES,P. *Inst. Inv. Pesq*., Barcelona, Vol. 2. Pags 851-871.

Balguerías, 2009. Review of assessment methods used by the CECAF working groups and their level of documentation. Deliverable D3.1. Improve Scientific and Technical Advices for fisheries Management (ISTAM). 18 pp.

Barros, P., 2007. Projections of future yields and stock abundance using dynamic surplus production models: general concepts. And implementation as excel spread sheets. In: Report of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa. *FAO Fisheries Report* No. 849: 213-224.

Barton, E. D., Arístegui, J., Tett, P., Cantón, M., García-Braun, J. A., Hernández-Leon, S., 1998. The transition zone of the Canary Current upwelling region. *Progress in Oceanography*, 41, 457-503.

Barton, E.D. 1985. Structure and variability of the central water mass front off Cabo Blanco. Int. Symp. Upw. W Afr*., Inst. Inv. Pesq., Barcelona,* I, pp 49-61.

Bécognée P., Moyano M., Almeida C., Rodríguez J. M., Fraile E., Hernández A., Hernández S. 2009. Mesoscale distribution of clupeoid larvae in an upwelling filament trapped by a quasi-permanent cyclonic eddy off Northwest Africa. *Deep-Sea Research* I 56, 330-343.

Belveze, H. et Bravo de Laguna, J., 1980. Les ressources halieutiques de l'Atlantique Centre Est. Deuxième partie: Les ressources de la côte ouest africaine entre le 24ºN et le Détroit de Gibraltar. *FAO Doc.tech.Pêches*. 186.2. 64 pp.

Berrit, G.R. and J. P Rebert. 1977. Océanographie physique et productivité primaire, p. 1-60. In: G.R. Berri (ed.) Le milieu marin de la Guinée Bissau et ses ressources vivantes. ORSTOM. Paris.

Bezzi, S. I., Verazay, G. A. and Dato, C. V. 1995. Biology and fisheries of Argentine hakes (M. hubbsi and M.australis). In: J. Alheit and T. Pitcher (eds.). Hake: Biology, fisheries and markets Series 15: 239-267. Chapman & Hall, London, Reino Unido.

Binet, D., 1997. Climate and pelagic fisheries in the Canary and Guinea Currents 1964-1993: The role of trade winds and the Southern Oscillation. *Oceanologica Acta*. 20. 177-190.

Binet, D., le Reste, L. and Diouf, P. S. 1995. The influence of runoff and fluvial outflow on the ecosystems and living resources of west african coastal waters. Effects of riverine inputs on coastal ecosystems and fisheries resources. *Fao Fisheries Technical Paper* 349, 133 pp.

Botha, L. 1986. Reproduction, sex ratio and rate of natural mortality of Cape hakes *Merluccius capensis* Cast. and *M. paradoxus* Franca in the Cape of Godd Hope area. *S.Afr. J. mar. Sci.* 4:23-35.

Bourdine, J. 1986. Quelques aspects biologiques des stocks de merlus dans la division statistique du Sahara littoral (34.1.3) en 1979-1982. En: Rapport du Premier Groupe de travail spécial sur les pêcheries de merlus et de crevettes profondes dans la zone nord du COPACE. *FAO, COPACE/PACE Sér*., 86/33: 121-138.

Brink, K.H., 1983. The near-surface dynamics of coastal upwelling. *Prog. Oceanogr*. 12:223-257.

Camp, L., Nykjaer, L., Mittelstaedt, E. and Schlittenhardt, P. 1991. Upwelling and boundary circulation off Northwest Africa as depicted by infrared and visible satellite observations. *Progress In Oceanography*. 26. 357-402

Caverivière, A., Thiam, A., Thiam, D., López Abellan, J.L. 1986. Rapport de synthese des quatres campagnes conjointes hispano-senegalaises de chalutages sur les stocks profonds du Senegal (1982-1984). *Arch. Cent. Rech. Oceanogr. Dakar-Thiaroye*, 151, 233 pp.

Commission of the European Communities, 2006. Communication from the Commission to the Council and the European Parliament- Implementing sustainability in EU fisheries through maximum sustainable yield . COM (2006) 360 final. 13 pp.

Commission of the European Communities, 2009. Communication from the Commission, Consultation on fishing opportunities for 2010. Com (2009) 224 16pp

Clarke, A.J. 1989. Theoretical understanding of eastern ocean boundary poleward undercurrents. *In*: Neshyba, S. J., Ch. N. K. Mooers, R.L. Smith, R.T. Barber (Eds) *Poleward Flows along Eastern Ocean Boundaries*, Springer-Verlag: 26-39.

Cury, P. & Roy, C. 1989. Optimal environmental window and pelagic fish recruitment succes in upwelling areas. *Can. J. Fish. Aquat. Sci*., 46: 670-680.

Decision Ministerielle Nº 001/CR/10. 2010 Portant sur la mise en place d'un plan d'amenagement de la pêcherie de la crevette rose. Ministere de l'Agriculture et de la Pêche Maritime. Departement de la Pêche Maritime : 4 pp. (15 Décembre 2010).

De Pontual, H., Groison, A. L., Piñeiro, C. and Bertignac, M., 2006. Evidence of underestimation of European hake growth in the Bay of Biscay, and its relationship with bias in the agreed method of age estimation. *ICES Journal of Marine Science*, 63: 1674-1681.

Demarcq, H. and Faure, V., 2000. Coastal upwelling and associated retention indices derived from satellite SST. Application to Octopus vulgaris recruitment. *Ocean. Acta*. 23, 391–408.

Diop, M., Sobrino, I., Fernández, L., Garcia, T. et Ramos, A., 2004. Evolution des prises accesoires des pêcheries spécialisées crevettière et merluttière dans les eaux mauritaniennes de 1950 à nos jours. En: Chavance, P., Ba, M., Gascuel, D. , Vakily, J. M. & Pauly D. (eds.). *Rapports de recherche halieutique ACP-UE Fisheries*, 15: 139-152.Fernández, M.A.R. y M.T.G. Santamaría. 1990. Analyse des donnés de composition en longueur des captures de sardine (*Sardina pilchardus* Walb.) utilisées au COPACE. *FAO. COPACE/PACE Ser.*, 90/50: 143-148. Roma, Italia.

Domain, F., 1980. Contribution à la connaissance de l'ecologie des poissons démersaux du plateau continental sénégalo-mauritanien. Les ressources démersales dans le contexte general du Golfe de Guinée. Thèse Univ. Pierre et Marie Curie, Paris VI. Vols.I-II. 342pp.

Doutre, M.P., 1960. Les merlus du Senegal. Mise en evidence d'une nouvelle espèce. *Rev. Trav. Inst. Scient. Tech. Pêche*, 24 (4): 513-536.

Elmoussaoui, A., S. Djenidi, A. Kostianoy. 2003. Physical processes study in the transition zone of the Northwest African upwelling: Climatological data analysis. *Geophysical Research Abstracts* 5: 11465.

FAO. 1978. Report of the ad hoc working group on hakes (*Merluccius merluccius, M. senegalensis, M. cadenati*) in the northern zone of CECAF. *CECAF/ECAF Ser.*, 78/9: 93 pp. FAO, Roma, Italia.

FAO. 1979. Evaluation of the fishery resources of the Eastern Central Atlantic. Report of the fourth session of the working party on resource evaluation of the fishery committee for the eastern central Atlantic (CECAF). *FAO Fish.Rep.*220. 200 pp. Dakar, 23-27 april 1979.

FAO. 1986a. Rapport du premier groupe de travail spécial sur les pêcheries de merlus et de crevettes profondes dans la zone nord du COPACE. *COPACE/PACE Sér.*, 86/33: 295 pp. FAO, Roma, Italia.

FAO. 1986 b. Rapport du groupe de travail CNROP/FAO/ORSTOM sur le description et évaluation des ressources halieutiques de la ZEE mauritanienne. *COPACE/PACE Sér*. 86/37: 310 pp. FAO, Roma, Italia.

FAO. 1986 c. Report of the First ad hoc Working Group on Seabreams (Sparidae) Stocks in the Northern CECAF Zone. *COPACE/PACE Sér*. 86/38: 445 pp. FAO, Roma, Italia.

FAO. 1989. Rapport du 2 ème groupe de travail CNROP/FAO/ORSTOM sur le description et évaluation des ressources halieutiques de la ZEE mauritanienne: description, évaluation et aménagement. *COPACE/PACE Sér*. 89/49: 237 pp. FAO, Roma, Italia.

FAO. 1990. Rapport du groupe de travail sur les merlus et les crevettes d'eaux profondes dans la zone nord du COPACE. *COPACE/PACE Sér*., 90/51: 249 pp. FAO, Roma, Italia.

FAO 1991. Artisanal fisheries in West Africa. Report of the Fifth IDAF Liaison Officiers Meeting. Cotonou, IDAF Project, IDAF/WP/38. 140 pp.

FAO. 1997. Rapport du groupe de travail sur les merlus et les crevettes d'eaux profondes dans la zone nord du COPACE. *COPACE/PACE Sér*., 97/62: 90 pp. FAO, Roma, Italia.

FAO. 1999. Rapport du 4ème groupe de travail CNROP sur le evaluation des stocks et amenagement des pecheries de la ZEE mauritanienne. *COPACE/PACE Sér*., 99/64: 180 pp. FAO, Roma, Italia.

FAO. 2006 a. Report of the FAO/CECAF Working Group on the Assessment of Demersal Resources. Conakry, Guinea, 19-29 September 2003. *FAO CECAF/ECAF Series* 06/67, 357 pp. Rome, Italy.

FAO. 2006 b. Rapport du Groupe de travail FAO/COPACE sur l'évaluation des ressources démersales-Sous-groupe Nord. Saly Senegal, 14-23 septembre 2004. *FAO COPACE/PACE Séries* 06/68, 219 pp. Rome, Italy.

FAO, 2007. Report of the FAO/CECAF Working Group on the Assessment of Demersal resources. Subgroup North. Banjul, The Gambia. *CECAF/ECAF Series*. Rapport du Groupe de travail FAO/COPACE sur l'évaluation des ressources démersaux- Sous-groupe Nord. Banjul, The Gambia. FAO. Rome (in press).

FAO, 2010. Report of the FAO/CECAF Working Group on the Assessment of Demersal resource. Subgroup North. Agadir, Morocco, 8-17 February 2010. / Rapport du Groupe de travail FAO/COPACE sur l'évaluation des ressources démersaux- Sous-groupe Nord. Agadir, Maroc, 8-17 fevrier 2008. CECAF/ECAF Series. FAO. Rome (in press).

Faure, V., Inejih, C.A., Demarcq, H. and Cury, P., 2000. The importance of retention processes in upwelling areas for recruitment of Octopus vulgaris: the example of the Arguin Bank (Mauritania). *Fisheries Oceanography.* Vol. 9 (4): 343-355.

Fernández-Peralta, L. et Meïsse, B. 2003. Pêcheries des merlus noirs (*Merluccius senegalensis* et *M. polli*) dans les eaux mauritaniennes. Essai d'évaluation avec FiSAT II.

Fernández, L., Ramos, A. y González, R. 1998. La pesquería de volanta en aguas del reino de Marruecos. *Inf. Téc. Inst. Esp. Oceanogr.*, 170, 84 pp. Madrid, España.

Fernández, L., Salmerón, F. and Ramos, A. 2004. Changes in elasmobranches and other incidental species in the Spanish deep-water black hake trawl fishery off Mauritania (1992-2001). *J. Northw. Atl. Fish. Sci.*, Vol. 35: 1-7.

Fernández, L., Ramos, A., Meiners, C. and Diop, M. 2006 a. Occurrence and distribution of black hakes *Merluccius senegalensis* and *Merluccius polli* off Mauritania. 11Th-International Deep-sea Biology Symposium. Southampton, UK 9-14 July.

Fernández, L., Salmerón, F., Ramos, A. and Kallahi, M. 2006 b. Some biological parameters of black hakes, Merluccius senegalensis and Merluccius polli in deep Mauritanian waters. 11TH International Deep-Sea Symposium, Southampton, UK, 9-14 July 2006.

Fernández, L., Meissa, B., Thiao, D. et Ramos, A. 2007. Rapport de la rencontre IMROP/CRODT/IEO pour la validation des statistiques de merlus noirs dans la zone COPACE. *Sér. CECAF/ECAF*. Anexo, 25 pp.

Fernández, L., Meiners, C., Ramos, A., Hernández, C., Presas, C., Faraj, A., Bouzouma, M. and survey team. 2008. North-west African hakes: a comparison with other hake's stocks of the EBUS. Eastern boundary upwelling ecosystem: integrative and comparative approaches. 2-6 June 2008, Las Palmas de Gran Canaria, Spain.

Fernández-Peralta, L. 2009. Pêcherie des merlus du Sénégal. *Informe Técnico. Banco Mundial, Agencia de Cooperación Francesa y Agencia de Cooperación Española y Desarrollo (AECID)*, Dakar (Senegal). Octubre 2009, 50 pp.

Fernández-Peralta, L., Salmerón, F., Rey, J., Puerto, M.A and García-Cancela, R. (in press) Reproductive biology in black hakes (*Merluccius polli* y *M. senegalensis*) off Mauritania. *Ciencias Marinas* (acepté juin 2010).

FISHERIES PARTNERSHIP AGREEMENT between the European Community and the Republic of Guinea-Bissau for the period 16 June 2007 to 15 June 2011. (OJ L 342 27.12.2007, p. 5–37).Fraga F., E.D. Barton E.D., O. Llinas. 1985. The concentration of nutrient salts in «pure» North and South Atlantic Central Waters. *Int. Symp. Upw. W Afr., Inst. Inv. Pesq*., Barcelona. V. I.: 25-36.

Fraile-Nuez, E., Machín, F., Vélez-Belchí, P., Lóez-Laatzen, F., Borges, R., Benítez-Barrios, V. and Hernández-Guerra, A. 2010. Nine years of mass transport data in the eastern boundary of the North Atlantic Subtropical Gyre, *J. Geophys. Res.* 115

Freudenthal, T., Meggers, H., Henderiks, J., Kuhlmann, H., Moreno, A. and Wefer, G. 2002. Upwelling intensity and filament activity off Morocco during the last 250,000 years. *Deep-Sea Research Part II-Topical Studies in Oceanography***,** 49(17)**,** 3655-3674.

García, S. 1982. Distribution, migration and spawning of the main fish resources in the northern CECAF area. *CECAF/ECAF Ser.*, 82/25: 9 pp., 11 map. FAO, Roma, Italia.

García-Isarch, E., Burgos, C., Sobrino, I., Mendes, A., Barri, I., Assau, V., Gomes, R. and Gomes,M., 2009. Informe de la campaña de evaluación de recursos demersales de la ZEE de Guinea-Bissau a bordo del B/O Vizconde de Eza "GUINEA-BISSAU 0810". Instituto Español de Oceanografía y Centro de Investigaçao Pesqueira Aplicada de Guinea-Bissau. (Mimeo)

García-Isarch, E., Muñoz I., Gomes, R., Burgos, C. and Sobrino, I. 2010. Distribution, abundance and biological aspects of the deepwater rose shrimp *Parapenaeus longirostris* and the striped red shrimp *Aristeus varidens* in waters off Guinea-Bissau (North West Africa). *Abstr. XVI Simposio Ibérico de Estudios de Biología Marina,* Alicante, Spain, 6-10 September 2010.

Goñi, R. y A. Cervantes. 1986. Contribución al conocimiento de la maduración sexual, época de puesta y sex-ratio de la merluza europea (*Merluccius merluccius* L., 1758) de África Occidental. En: *Rapport du Premier Groupe de travail spécial sur les pêcheries de merlus et de crevettes profondes dans la zone nord du COPACE. COPACE/PACE Sér.*, 86/33: 266-276. FAO, Roma, Italia.

Hagen, E., C. Zulicke and R. Feistel. 1996. Near-surface structures in the Cape Ghir filament off Morocco. *Oceanologica Acta*, 19 (6): 577-598.

Heileman, S., 2009. Guinea Current LME. In: Sherman, K. and Hempel, G. (eds.) *The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas*. UNEP Regional Seas. Report and Studies No. 182. UNEP, Nairobi, Kenya.Pp: 117-130.

Heileman, S. and Tandstad, M., 2009. Canary Current LME. In: Sherman, K. and Hempel, G. (eds.) *The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas*. UNEP Regional Seas. Report and Studies No. 182. UNEP, Nairobi, Kenya. pp: 130-142.

Hernández-Guerra, A. and L. Nykjaer. 1997. Sea surface temperature variability off north-west Africa: 1981-1989. *International Journal of Remote Sensing* 18: 2539-2558.

Iborra, J. 2010. La pesca en Mauritania y los acuerdos pesqueros con la UE. Nota del Departamento Temático B: Políticas Estructurales y de Cohesión. Dirección General de Políticas Interiores de la Unión. Parlamento Europeo. IP/B/PECH/NT/2010_04. PE 438.610. 68 pp. http://www.europarl.europa.eu/studies.

ICES, 2010a. An MSY framework for advice. Unpublished draft discussion document available.at: http://groupnet.ices.dk/WKFRAME2010/Background%20and%20working%20documents/Forms/AllItems.aspx (document called MSY concept paper). ICES CM 2010/ACOM.

ICES, 2010b. Report of the Workshop on Implementing the ICES Fmsy framework , 22-26 March 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:54. 83 pp.

Jiménez, M. 2006. Acuerdos pesqueros con países lejanos. Análisis de la pesquería de *Merluccius senegalensis* en aguas mauritanas: un análisis de eficiencia. Tesina doctoral. Facultad de Ciencias Económicas y Empresariales. Universidad de Cádiz.

Kearns, E.J. and M.E. Carr. 2003. A hydrographic and nutrient climatology of four eastern boundary current regions. *Deep-Sea Research* II. 50(22-26): 3171-3198.

Knoll, M., B. Lenz, F. López Laatzen, T.J. Müller, G. Siedler. 2002. The Eastern Boundary Current System between the Canary Islands and the African coast. *Deep-Sea Research* II 49: 3427-3440.

Lloris, D., Matallanas, J., Oliver, P. 2003. Merluzas del mundo (Familia Merlucciidae). Catálogo comentado e ilustrado de las merluzas conocidas. *FAO Catálogo de Especies para los Fines de la Pesca*. Nº 2. Roma, FAO, 2003. 57 p. 12 láminas de color.

Longhurst, A., 1983. Benthic-Pelagic coupling and export of organic carbon from a tropical Atlantic continental shelf-Sierra Leone. *Estuarine, Coastal and Shelf Science,* 17: 261-185.

López-Abellán, L.J., Ariz Tellería, J. 1993. Aspectos generales de la distribución y biología de las especies del género Merluccius Rafinesque, 1810, en aguas de Senegal y Gambia (16º00'N-12º25'N). *Bol. Inst. Esp. Oceanogr*., 9(1), 101-121.

Manríquez, M. and Fraga, F. 1982. The distribution of water masses in the upweling region off Northwest Africa in November. *Rapp. P. V Reun. Cons. Int. Explr. Mer, 39-47.*

MRAG, 2005. Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries. Final Report. July 2005. 178 pp.

MRAG, 2010. Agnew, S.F. Walmsley, F. Leotte, C. Barnes, C. White, S. Good. West Africa Regional Fisheries Project. Estimation of the cost of illegal fishing in West Africa. Final Report. May 2010. 97 pp.

Martínez-Marrero, A., Rodríguez-Santana, A., Hernández-Guerra. A., Fraile-Nuez, E., López-Laatzen, F., Vélez-Belchí, P. and Parrilla, G. 2008. Distribution of water masses and diapycnal mixing in the Cape Verde Frontal Zone. *Geophys. Res. Lett*., 35, L07609, doi:10.1029/2008GL033229, 2008. 4922

Maurin, C. 1954. Les merlus du Maroc et leur pêche. *Bull. Inst. Pêches Marit. Maroc,* 2: 7-65. Casablanca, Marruecos.

McMaster, R.L., Lachance, T.P. and Ashraf, A., 1970. Continental shelf geomorphic features off Portuguese Guinea, Guinea and Sierra Leona (West Africa). *Marine Geology,* 9 (3): 203–213.

Meiners, C. 2007. Importancia de la variabilidad climática en las pesquerías y biología de la merluza europea *Merluccius merluccius* (Linnaeus, 1758) de la costa Noroccidental Africana. *Tesis Doctoral*, IEO-Univ. Politécnica de Cataluña: 187 pp.

Meiners, C., Fernández, L., Torres, P. and Ramos, A. 2006. Climate variability and recruitment success of European hake (*Merluccius merluccius* L.) in NW Africa. *ICES CM 2006/C: 15*, 19 pp., Maastricht, Netherlands.

Meiners, C., Fernández, L. and Ramos. A. 2007 a. Environmental variability and stock-recruitment relationships for European hake (*Merluccius merluccius* L.) off NW Africa. *Reproductive and Recruitment Processes of Exploited Marine Fish Stocks*, Lisbon, Portugal 1-3 October, 2007.

Meiners, C., Fernández, L. and Ramos, A. 2007 b. Spawning pattern and size at first sexual maturity of European hake off NW Africa: A geographical and environmental comparative approach. *Reproductive and Recruitment Processes of Exploited Marine Fish Stocks*, Lisbon, Portugal 1-3 October, 2007.

Meiners, C., Fernández, L., Salmerón, F. and Ramos, A. 2007 c. First approach about climate variability and fisheries dynamics of black hakes (*Merluccius polli* and *Merluccius*

senegalensis) in NW Africa. *Simposio GLOBEC-IMBER ESPAÑA*, Valencia, Spain, 28-31 mars 2007.

Meiners, C., Fernández, L., Salmerón, F. and Ramos, A. 2010. Climate variability and fisheries of black hakes (*M. polli* and *M. senegalensis*) in NW Africa: A first approach. *Journal of Marine System*, 80: 243-247.

Mittelstaedt, E. 1982. Large scale circulation along the coast of Northwest Africa. *Rapp.P.-v.Réun.Cons.int.Explor.Mer*. 180: 50-57.

Mittelstaedt, E. 1991. The ocean boundary along the northwest African coast. Circulation and oceanographic properties at the sea surface. *Progress in Oceanography* 26: 307–355.

Nykjær, L. and van Camp, L. 1994. Seasonal and interannual variability of coastal upwelling along northwest Africa and Portugal from 1981 to 1991. Journal of Geophysical Research 99(C7): 14197-14207.

Payne, I. L. and Punt, A. E. 1995. Biology and fisheries of South African Cape hakes (*M. capensis* and *M. paradoxus*). *In*: J. Alheit and T. Pitcher (eds.). *Hake: Biology, fisheries and markets Series* 15: 15-47. Chapman & Hall, London, Reino Unido.

Piñeiro, C., Rey, L., de Pontual, H. and García, A., 2008. Growth of Northwest Iberian Juvenile hake estimated by combining sagittal and transversal otolith microstructure analyses. *Fisheries Research* 93. 173-178.

Poinsard, F. (ed.). 1992. Synthèse sur l'état des ressources halieutiques dans la zone de pêche du Maroc: 206 pp. *DG-XIV, CEE*, Bruselas, Bélgica.

Postel, E. 1955. Le merlu noir (*Merluccius senegalensis* Cadenat). *Rapp. et Proc. Verb.*, Vol. 137. C.I.E.M.

Presas, C. 2011 a. Descripción de la Pesquería Española "Artesanal Norte" en aguas de Marruecos. Informe para el Comité de Seguimiento del Acuerdo Pesquero UE-Reino de Marruecos. IEO-Centro Oceanográfico de Canarias.13 pp.

Presas, C. 2011 b. Descripción de la Pesquería Española "Artesanal Sur" en aguas de Marruecos. Informe para el Comité de Seguimiento del Acuerdo Pesquero UE-Reino de Marruecos. IEO-Centro Oceanográfico de Canarias.19 pp.

Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Kingdom of Morocco (OJ L 141, 29.05.2006, p. 9–37)Punt, A. E. and R. Hilborn, 1996. Biomass dynamics models. User's manual. *FAO Computerised Information Series. FAO*, Rome. 66 pp.

Protocol setting out the fishing opportunities and financial contribution provided for in the Fisheries Partnership Agreement between the European Community and the Islamic Republic of Mauritania for the period 1 August 2008 to 31 July 2012. (OJ L 203, 31.07.2008, p. 4–59) Ramos, A., Sobrino, I., Fernández, L. and González, J.F. 1991: The "Guinea 90" Survey. *FAO CECAF/ECAF Ser.* 91/52, 295 pp., 8 maps.

Ramos, A. y Fernández, L.1992. La pesquería española de arrastre de merluzas negras en aguas mauritanas: Análisis de la serie histórica de datos. *Inf. Téc. Inst. Esp. Oceanogr.,* 118: 67 pp. Madrid, España.

Ramos, A. y Fernández, L. 1994. Las pesquerías de merluzas en los caladeros de África Noroccidental: Datos de base del año 1991**.** *Inf. Téc. Inst. Esp. Oceanogr.*, 153: 132 pp. Madrid, España.

Ramos, A. and Fernández, L. 1995. Biology and fisheries of North-west African hakes (*M. merluccius*, *M. senegalensis* and *M. polli*). En: J. Alheit and T. Pitcher (eds.). *Hake: Biology, fisheries and markets Series 15*: 89-124. Chapman & Hall, London, Reino Unido.

Ramos, A., I. Sobrino y L. Fernández. 1996. Biología de la merluza europea, *Merluccius merluccius* Linnaeus, 1758, en las costas de África Noroccidental. En*:* Llinás, O., J.A. González y M.J. Rueda (eds.). *Oceanografía y Recursos marinos en el Atlántico Centro-Oriental*: 223-240. Las Palmas de Gran Canarias, España.

Ramos, A., Fernández, L. and R. González. 1998. The black hake fishery in the Mauritanian EEZ: Analysis of the possible application of a 30 cm minimum. *Inf. Téc. Inst. Esp. Oceanogr.*, 173, 40 pp. Madrid, España.

Ramos, A., González, R., García, T., Sobrino, I. y Fernández, L. 2000. La crisis en el acceso al caladero marroquí: análisis de la evolución y situación de las pesquerías y recursos de merluzas y crustáceos. *Inf. Téc. Inst. Esp. de Oceanogr.*, 178: 171 pp. Madrid, España.

Ramos, A., Faraj, A., Balguerías, E, Belcaid, S., Burgos, C., Gómez, M., González, J. F., Hakim, M., Hernández, C., Manchih, K., Meiners, C., Ramil, F., Salmerón, F., J.L. Sanz y J. Settih. 2005. Informe de resultados de la Campaña 'Maroc-0411'. Prospección por arrastre de los recursos demersales profundos del norte de Marruecos. *Inf. Int. IEO-INRH*: 230 pp + Anexos.

Rey, J., Fernández-Peralta, L., Esteban, A., García Cancela, R., Salmerón, F., Puerto, M.A. and Piñeiro, C.G. Does otolith macrostructure record environmental or biological events? the case of black hake (*Merluccius polli* and *Merluccius senegalensis*). *Fisheries Research.* (acepted in June 2011)

Seibold, E. and Fütterer, D**.** 1982. Sediment dynamics on the Northwest African continental margin. In: The Ocean Floor, Bruce Heezen commemorative volume (Ed M. Talwani), pp. 147-163. John Wiley & Sons., Chichester.

Sobrino, I., Cervantes A. y Ramos. A.1990. Contribución al conocimiento de los parámetros biológicos de la merluza senegalesa (*Merluccius senegalensis* Cadenat,1950) del área COPACO. En: *Rapport du groupe de travail sur les merlus et les crevettes d'eaux profondes dans la zone nord du COPACE. COPACE/PACE Sér*., 90/51: 139-154. FAO, Roma, Italia.

Sobrino, I. y García. T. 1992. Análisis y descripción de las pesquerías de crustáceos decápodos en aguas de la República Islámica de Mauritania durante el período 1987-1990. *Inf. Téc. Inst. Esp. Oceanogr*., 112: 38pp.

Thiam, D. A. C. et Thiam, M. 1984. La pêche des crevetes espagnols au large du Sénégal em 1980 et Recapitulatif sommaire des resultats pour le période 1977 à 1979. *Doc. Scient. CRODT*, pp.241.

Tingley, G. A., Purchase, L. V., Bravington, M. V. and Holden, S.J. 1995. Biology and fisheries of hakes (*M. hubbsi* and *M. australis*). *In*: J. Alheit and T. Pitcher (eds.). *Hake: Biology, fisheries and markets Series* 15: 269-303. Chapman & Hall, London, Reino Unido.

Tomczak, M. Jr. 1978. De l'origine et la distribution de l'eau remontée à la surface au large de la côte Nord-Ouest Africaine. *Annales Hydrographiques,* Serie 5(6): 5-41.

Turner, J. and M. El Ouari. 1986. State of the explotation of *Merluccius merluccius* off the coast of Northern Morocco. En*: Rapport du Premier Groupe de travail spécial sur les pêcheries de merlus et de crevettes profondes dans la zone nord du COPACE. COPACE/PACE Sér.*, 86/33: 51-71. FAO, Roma, Italia.

Riis-Vestergaard, J., Velasco, F., Hill, L. and Olaso, I., 2000. Food Consumption of European hake (Merluccius meruccius) estimated by application of a bioenergetics model: Is the growyh of hake underestimated? ICES C. M. 2000/Q 11, 15 p.

UNCLOS-UN, 1982. United Nations Convention of the Law of the Sea of December 1982.

Wooster, W.S. and J.L. Reid.1963. Eastern boundary currents. In The sea (M.N.Hill,ed.). New York, Vol.2:253–280.

Wynn, R.B., Masson, D.G., Stow, D.A.V. & Weaver, P.P.E. 2000. The Northwest African slope apron: a modern analogue for deep-water systems with complex seafloor topography. *Marine and Petroleum Geology* 17, 253-265.

Wysokinski, A. 1986. Evaluation des stocks de merlus dans les divisions statistiques 34.1.3 et 34.3.1 du COPACE, basée sur des données polonaises (1966-1975). En*: Rapport du Premier Groupe de travail spécial sur les pêcheries de merlus et de crevettes profondes dans la zone nord du COPACE. COPACE/PACE Sér.,* 86/33: 72-120. FAO, Roma, Italia.