Description of environmental issues, fish stocks and fisheries in the EEZs around the Azores and Madeira

October 2012

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Terms of reference

For fishery resources in the EEZs around the Azores and Madeira, you are requested: To describe the main stocks and fisheries (differentiating between local, resident and others) within the EEZs. The description should cover fish stock status, fishing fleets, fishing techniques, yields and the economic and social performances of these fisheries. To describe the main environmental issues related to these fisheries; bycatch of sensitive species, effects of fisheries on natural habitats and influence of the environmental quality of the water on fisheries performance.

Background

According to Article 33 of Council Regulation (EC) 2371/2002, the STECF shall be consulted regularly on the status of EU fisheries including biological, economic and social aspects. Information on fish stocks and fisheries around the outermost regions (OR's) is limited and have not been assessed systematically. This prevents the Commission to fully implement the CFP in these regions, which on the other hand deserve a differential treatment by reason of their special geographical characteristics (insularity, remoteness, etc.).

Request for Services
Commitment no. SI2.615631
Legal base: Commission Decision 2005/629/EC
OJ L37, P. 52 of 4 February 2010

Prepared by
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Introduction

The Azores is a Portuguese archipelago composed of nine islands, with a maritime territory spreading over a million square kilometres for which marine resources are central to the local economy (Figure 1). With the absence of continental shelf and surrounding great depths, fishing occurs around the island slopes and many seamounts present in the area (Morato et al., 2008a; Silva and Pinho, 2007). Commercial whaling was the first large-scale commercial fishery, peaking in the 1940s and decreasing by the 60s as it was being substituted by the more profitable fisheries such as the pole-and-line tuna and demersal fisheries using handlines (Martin and Melo, 1983). The Madeira archipelago is composed of 2 islands (Madeira and Porto Santo islands), and the inhabited Desertas and Selvagens islands. Madeira has a maritime territory spreading over 430 thousand square kilometres. The sea floor is in general often rocky and irregular near shore, dropping almost abruptly along the slope. At around five nautical miles off the coast, depths can achieve more than 1800 m.

The amount of information available for these two regions varies substantially. While many scientific reports, peer-reviewed publications and statistics were found for the Azores, a limited number of published reports were found for Madeira. Accordingly, the detail of the reported facts will vary significantly. Local Madeira authorities will likely have much better and detail information regarding their fisheries and resources than what we present here.

The Azorean fishing industry saw significant changes during the 1980s as bottom and surface longlines were introduced (Pereira, 1988a; Menezes, 1996). In Madeira Islands, the traditional deepwater fishery probably started in the early 1800's when local fisherman were targeting "oil fish", i.e. deep-water squalid sharks, between 600-800m depth for its oil to be use in lighting their homes (Noronha, 1925). Due to its quality and flavour, this fish rapidly became the "trusty friend for poor local communities" (Noronha, 1925) and an important fishery for Madeira Island. This fishery was kept almost unaltered for over one century, when in 1982 hemp was replaced by monofilament drifting longline and the number of hooks per line increased (Martins and Ferreira, 1995). This change in fishing gear, along with better equipped boats that helped local fisherman searching for new fishing grounds such as seamounts, significantly improving their yields (Martins and Ferreira, 1995). The 1980s were also crucial for the fishing industry both in the Azores and Madeira as the expansion in air transportation allowed exportation of fresh fisheries products to mainland Portugal and foreign countries. In addition, subsidies for fleet renovation gave rise to fibber glass boats and iron tuna vessels equipped with high technological equipment such as sonar, increasing

vessel autonomy and allowing an expansion of the fishing activity further offshore and deeper areas (e.g. Pinho et al., 2001; Machete et al., 2011). In 1986, Portugal joined the European Economic Community (EEC) creating new trade opportunities for Azorean products. In parallel, a series of ports and landing sites with cold-storage posts were built (Silva et al., 1994; Menezes, 1996).

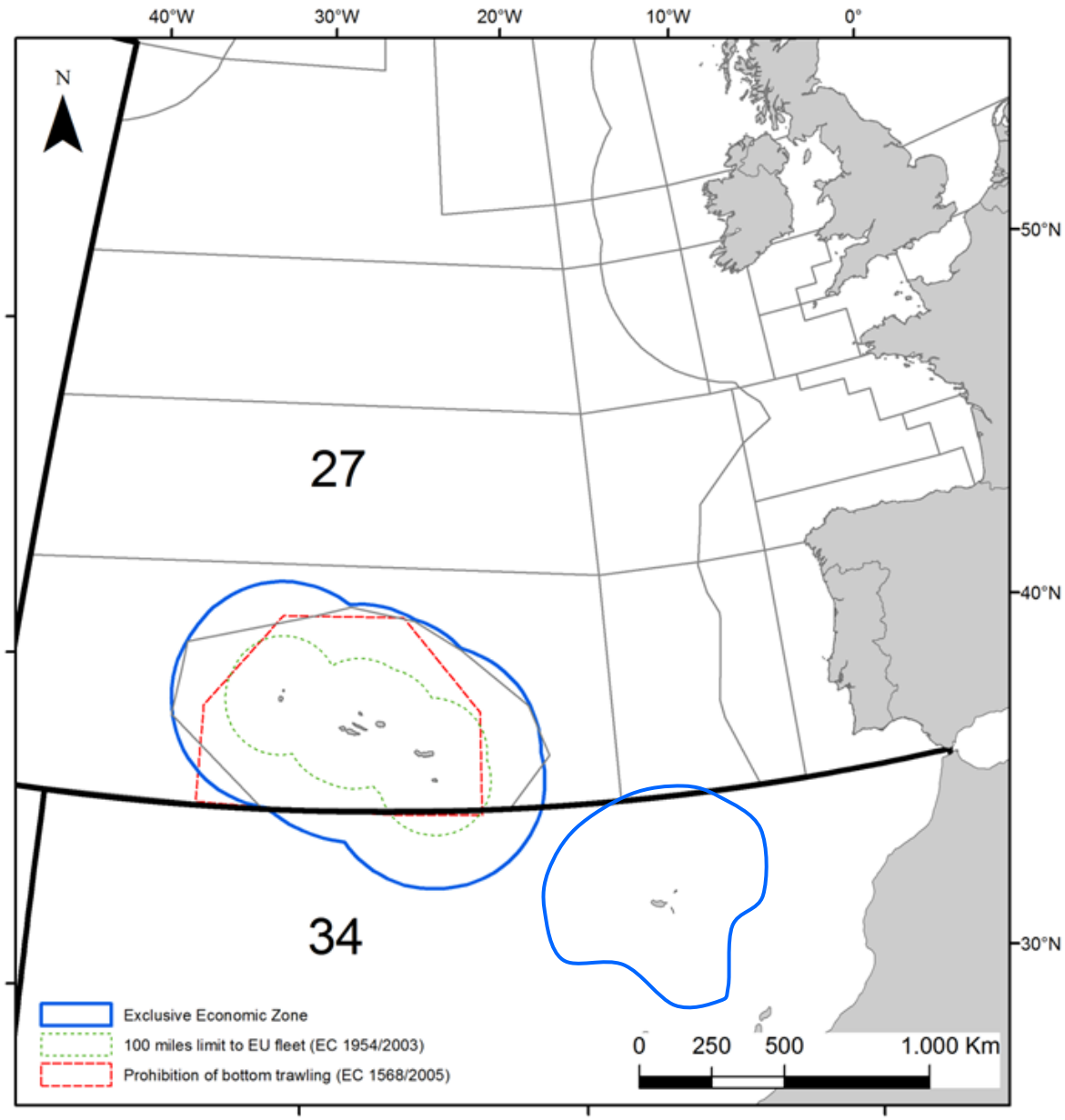

Figure 1. The Azores and Madeira archipelagos. Also showed the Azores 100 miles limit to EU vessels, area prohibited to bottom trawling, FAO statistical area and ICES rectangles.

The Azores fishing fleet is essentially a multi-species and multi-gear in character and can be divided into two main segments: 1) small-scale or artisanal fishing fleet that represents between 80 and 90 per cent of the fleet and 2) large-scale or semi-industrial fishing fleet, and includes vessels greater than 14 meters in length. The number of registered fishing vessels has dropped drastically over the last 10 years. The fact that their owners often have another job, the poor condition of the vessels, the lack of crewmen, and more recently, reaching established quotas are the main reasons why many vessels are not fully used (Morato et al., 2001, Silva and Goulding, 2003). The local fleet comprises mainly small (<12 meters in length) wooden open-deck vessels (less than 5 GRT), and are usually equipped to use more than one fishing method, such as hooks and line gear (handlines, jigs, bottom longline), surrounding nets, gill nets and traps, and constitute the so-called polyvalent segment of the fleet. The coastal fishing fleet operates in areas further from the coast and target essentially large pelagics and deep-water demersal species. The registered fishing fleet in 2008 comprised a total of 666 vessels: 537 small open and closed deck smaller than 10 meters in length, 61 small deck vessels between 10 and 12 meters, 46 larger deck vessels between 12 and 24 m and 22 greater than 24 meters. In 2010 these numbers may be slightly lower and (SREA, http://estatistica.azores.gov.pt). The fishing fleet operating in Madeira Islands consisted of 115 registered vessels in 2008, with a combined registered tonnage of around 2.3 thousand GT and total power of around 10.9 thousand kW (JRC, 2010). However, the Madeira Regional Service for Statistics (DREM, http://estatistica.gov-madeira.pt/) reported 502 fishing licenses in 2008. Total employment reported in Madeira for 2008 varied from 450 (http://estatistica.gov-madeira.pt/) to 550 (JRC, 2010).

Overall, the number of species landed in the Azores increased in recent years to about 106 in 2010 (Christopher Pham et al., unpub. data). The overall increase in species number reflects the introduction of new fishing gear, the exploitation of new fishing grounds and the increase value of some species. Total official statistics compiled for the Azores, for the period 2000-2010 suggests that annual commercial extractions varied between 7,100 tonnes in 2001 and 19,000 tonnes in 2010 (Figure 2). The annual fluctuations in total landings are mainly caused by fluctuations in the tuna fisheries. Today, the Azorean fishing industry is composed of four main components: fishery for small pelagic species (blue jack mackerel *Trachurus picturatus* and chub mackerel *Scomber colias*) using small nets and with total catch of 1,500 tonnes in 2010 (data obtained from Lotaçor, 2011), pole-and-line tuna fishery (14,000 tonnes in 2010), bottom longline and handline targeting demersal fishes (3,000 tonnes in 2010) and pelagic longline targeting swordfish, *Xiphias gladius* (150 tonnes in 2010). Additionally, there's a growing interest in black scabbardfish (*Aphanopus carbo*)

fisheries using drifting deep-water longline (Machete et al., 2011). In terms of landed value, the bottom longline fleet is by the one with greater value, followed by the pole and line and small pelagic fisheries (Figure 2). In Madeira, the fishery exploitation can also be divided in four components: the drifting deep-water longline targeting black scabbardfish (1,800 tonnes in 2010), the pole and line tuna fishery (1,800 tonnes in 2010), a coastal fishery for small pelagic species (550 tonnes in 2010), and bottom longline and handline fishery targeting demersal species (33 tonnes in 2010). In Madeira there is high diversity but low quantity of demersal species. Hence, the handline/longline fishery towards these species is less developed than in the Azores. The fishery towards the black scabbardfish is one of the oldest deep-water fisheries in the Atlantic, and also one of the most important ones in the region. It is currently the island's most important fishery resource; occupying a far greater traditional place in the island history than does the tuna fishery. Total official statistics compiled for the Madeira, for the period 2000-2010 suggests that annual commercial extractions varied between 4,700 tonnes in 2010 and 8.000 tonnes in 2004 (Figure 3). The annual fluctuations in total landings are mainly caused by fluctuations in the both tuna and black scabbardfish fisheries.

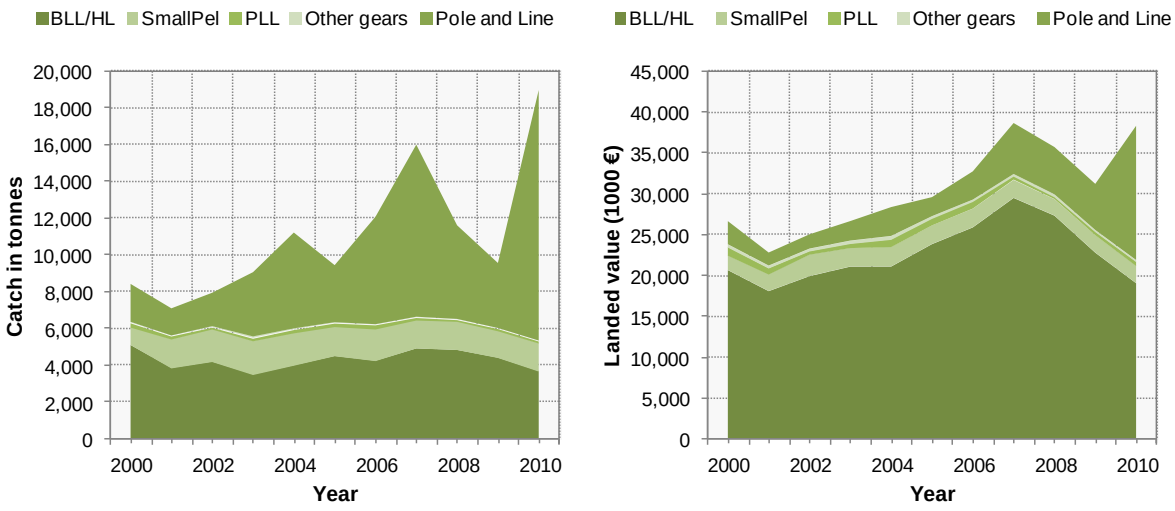

Figure 2. Annual landings (left) and landed value (right) of major fisheries components in the Azores for the period 2000-2010. BLL/HL is bottom longline and handline, SmallPel is small pelagic fisheries using surrounding nets, and PLL is pelagic longline.

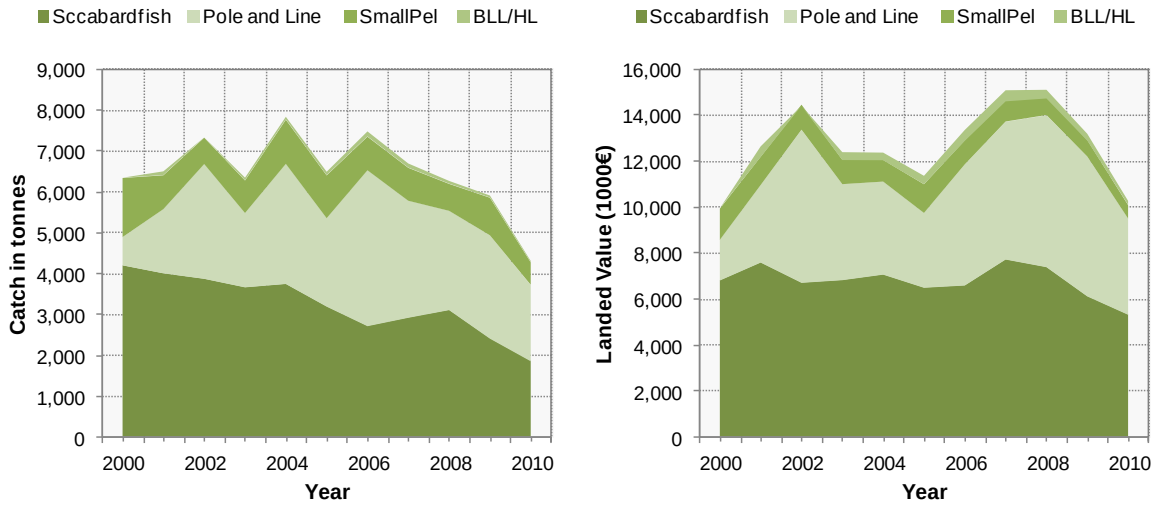

Figure 3. Annual landings (left) and landed value (right) of major fisheries components in the Madeira for the period 2000-2010. BLL/HL is bottom longline and handline and SmallPel is small pelagic fisheries using surrounding nets.

Note however, that some difficulties were identified when assigning components or gear type to each vessel as many use a combination of fishing gears throughout the year, and often even on the same fishing trip (Carvalho et al., 2011). To overcome this problem, Carvalho et al. (2011) analyzed annual landings in the Azores by species for each vessel to determine the main fishing gear since most gears are relatively selective and species group-specific. Handlines and bottom longline gears target and capture many of the same species making this distinction extremely challenging. Whenever two distinct gear types, such as a hook and line gear and a net gear, were used by the same boot with no prevalent gear, Carvalho et al. (2011) called them as polyvalent fishing vessels. No such exercise was tried with the Madeira fisheries, becoming extremely difficult to estimate annual landings by fleet.

The number of fishermen or crewmembers in the Azores have changed dramatically in recent years from about 4200 in 2000 to about 2100 in 2006 (SREA, http://estatistica.azores.gov.pt). In Madeira Islands, the number of fishermen have also decreased significantly from about 800 in 2004 to about 400 in 2010 (DGRM, http://estatistica.gov-madeira.pt). Carvalho et al. (2011) estimated a total of 2160 fishermen in the Azores for the reference year of 2005. The value appears to be a reasonable approximation taking into account the numerous challenges that exist when estimating the number of fishers, such as: the number of registered fishers is not usually representative of the number of active fishers; many fishers work only part-time and may migrate especially in the context of seasonal fisheries, which can produce different results at different times of the

year (Carvalho et al., 2011). Fishermen are usually paid according to the principle of the share system, which is a form of sharing the firm's margin, and varies from vessel to vessel (Carvalho et al., 2011). Usually in the small-scale sector, crewmembers (including owner) each get an equal share of the total net landings revenue. In the large-scale sector, this system differs somewhat in the sense that each crewmember receives a share according to their function, for example, the owner, skipper, and mechanics usually get a larger share (Carvalho et al., 2011). The small-scale sector in the Azores has actually increased in importance over the years, both in terms of landed volume and value. Small-scale fisheries employ more people, land slightly more catch and achieve a higher landed value per tonne than their larger counterparts (Carvalho et al., 2011). They are also less fuel intensive and appear to be less harmful to stocks and their habitats (Carvalho et al., 2011).

The Azores and Madeira have an efficient system for collection of fisheries data, dating back from the 1970s. With the exception of part of the pelagic longline catch landed outside of the Azores and tuna going directly to processing factories, all catches by Azorean vessels must be landed within the auction houses distributed throughout the islands. These auction houses all belong to one company (Lotaçor S.A.) responsible for transferring all landing data to local authorities. Tuna processing factories must report all landings to Lotaçor. The unique commercial fishing activity not entering local statistics is the catch of pelagic longliners landed outside of the Azores by Azorean vessels, mainland Portugal or foreign fleets. Even though possibly reported elsewhere, such removals get dissolve together with catches from other areas and are difficult to track down.

Most of the Azorean maritime territory is located within FAO statistical area 27 with the exception of the southernmost part, which lies within area 34 (Figure 1). Madeira maritime territory is located within FAO statistical 34. As being Portuguese archipelagos, catches from the Azorean and Madeira fleets are not distinguished from those of mainland Portugal and Madeira, in the statistics reported by FAO. Official catch statistics for the Azorean fleets had to be therefore compiled from various landing databases (Christopher Pham et al., unpub. data) while catch from Madeira were compiled from the Madeira Regional Service for Statistics (DGRM, http://estatistica.gov-madeira.pt).

The current fisheries resource management strategy of the Azores and Madeira is based on the EU Common Fishery Policy, implemented primarily through Total Allowable Catches (TACs) for various species including blackspot seabream (*Pagellus bogaraveo*), alfonsinos (*Beryx splendens and B. decadactylus*), and deepwater sharks such as *Deania* spp., *Centrophorus* spp., *Etmopterus* spp., *Centroscymnus* spp. and kitefin shark, *Dalatias licha*

(EC Reg. 2340/2002; EC Reg. 2270/2004). Apart from fish quotas, the Azores and Madeira Regional Governments have implemented technical measures such as minimum landings sizes or weights, minimum mesh sizes, allowable percentage of bycatch species, area and temporal closures (Morato et al., 2010) and ban on the use of specific gear. Examples include the Azores and Madeira regulation that prohibited deep-sea trawling, which recently became an EC regulation (EC 1568/2005) and the Azorean box of 100 miles limiting fishing to vessels registered in the Azores created in 2003 under the CFP (EC Reg. 1954/2003). Besides these fisheries regulations, measures protecting species are normally related to habitat management. There are currently 11 designated marine protected areas (MPAs) in the Azores and 6 in Madeira and new areas have been recommended. There is a profusion of legislation for conservation in the Azores, however, it needs to be implemented, enforced and respected (Santos et al., 1995).

Fishery resources in the EEZ of the Azores

Bottom Longline and handline

Fisheries

Fishing techniques

Many different types of longlines and handlines are used in the Azores (Figure 4). One of the most common longline gear used in the commercial demersal fishery in the Azores have both a stone/buoy (Figure 5) or stone/stone configuration (Menezes, 2003). The longlines are usually set from four sided skates, with about 30 size nº 9 hooks by quarter-skate side, of approximately 36.5 m long. On average 12 skates gear length cover approximately 1 nautical mile (Menezes, 2003). The bait used is mostly chopped salted sardine or mackerel. The artisanal fleet operates mainly during the summer months, with fishing trips lasting for a day or week at the most, and deploy up to 1,500 hooks per set. The large-scale fleet operate all year round, with fishing trips lasting up to a month and deploy on average 2,500 hooks per set (Carvalho, unpub. data). Since 2000, the use of bottom longlines in the coastal areas has significantly been reduced, as a result of the banning by of its use in the coastal areas on a range of 3 miles from the shore. As a consequence, the smaller boats that operate in this area have changed their gears to several types of handlines, which may have increased the pressure on some species. The deep-water bottom longline is at present mostly a seamount fishery. Also in one other fleet component, the medium size boats, ranging from 12 to 16 m, a change from bottom longline to handlines has been observed during the last 5 or 6 years. All these changes in the fishing pattern of the fleet may explain the changes in the landings of some species that were more vulnerable to the use of bottom longlines (ICES, 2011a).

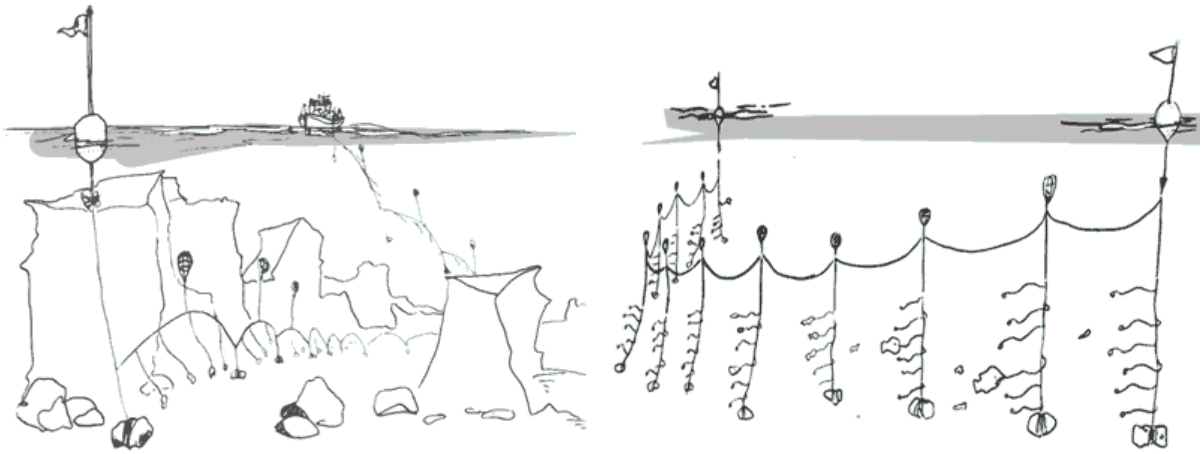

Figure 4. Drawing exemplifying the bottom longline fishing techniques for demersal species in the Azores (downloaded from http://www.pescas.net/artespescas.php).

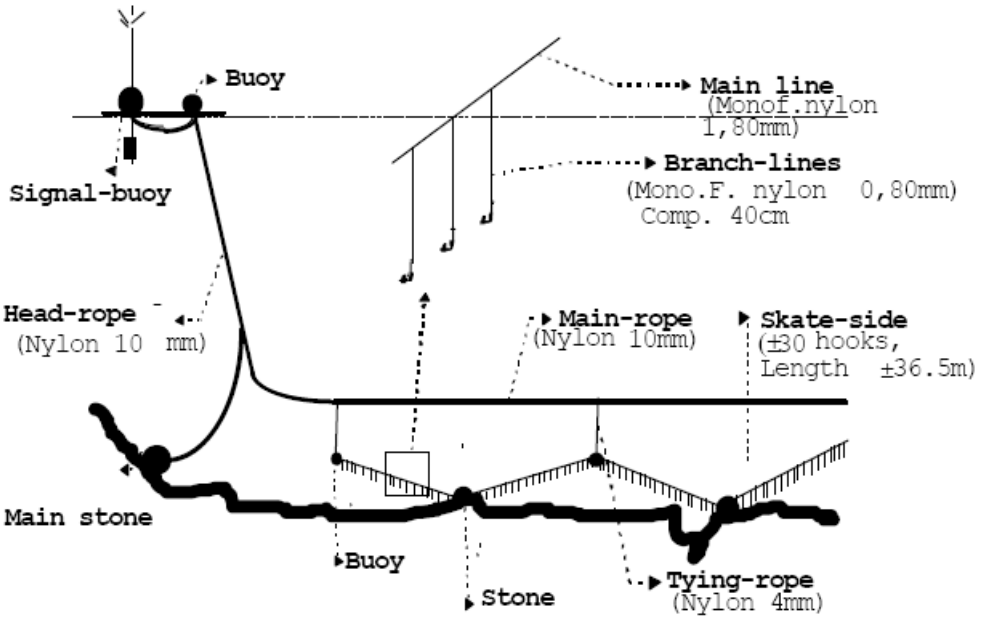

Figure 5. Schematic representation of the bottom longline gear used in the Azores (adapted from Menezes, 2003).

Fishing fleet

According to Carvalho et al. (2011) there were in 2005 about 75 bottom longliners of different sizes operating in the Azores: 23 vessels of length smaller than 8 m, 33 vessels between 8-12 m, 14 of length between 12-20 m, and 5 vessels of length between 20-30 m. The number of handline boats was estimated at 378 (Carvalho et al., 2011): 257 vessels of length smaller than 8 m, 106 vessels between 8-12 m, and 15 of length between 12-20 m. These numbers are only approximations because of the difficulties in assigning components or gear type to each vessel. Additionally, there are an extra of 89 boats operating with both hooked gears and nets (Carvalho et al., 2011). These vessels were not accounted here.

Fish species and yields

Total landings of the bottom longline and handline components of the Azores commercial fisheries averaged 4.2 thousand tonnes (Figure 6). This value has a high uncertainty not because of high discards rates but because of the difficulty to correct assign landings to fishing gears. The bottom longline and handline fishery contributes from 20% to 60% of all landed weight in the Azores. These fluctuations are related with fluctuations in the tuna landings and thus the total landings in the Azores. Catches from demersal fisheries usually

include more than 20 species with economic value. Some of the most important species for the period 2000-2010 (Figure 7) are the blackspot seabream with average annual landings of 1,000 t, the conger eel (*Conger conger*) with average landings of about 400 t, the squid (*Loligo forbesi*) with about 400 t, the wreckfish (*Polyprion americanus*) with about 350 t, bluemouth rockfish (*Helicolenus dactylopterus*) with about 280 t, the two species of alfonsinos with about 210 t, the forkbeard (*Phycis phycis*) with about 190 t, and the common red porgy (*Pagrus pagrus*) with annual landings reached 100t.

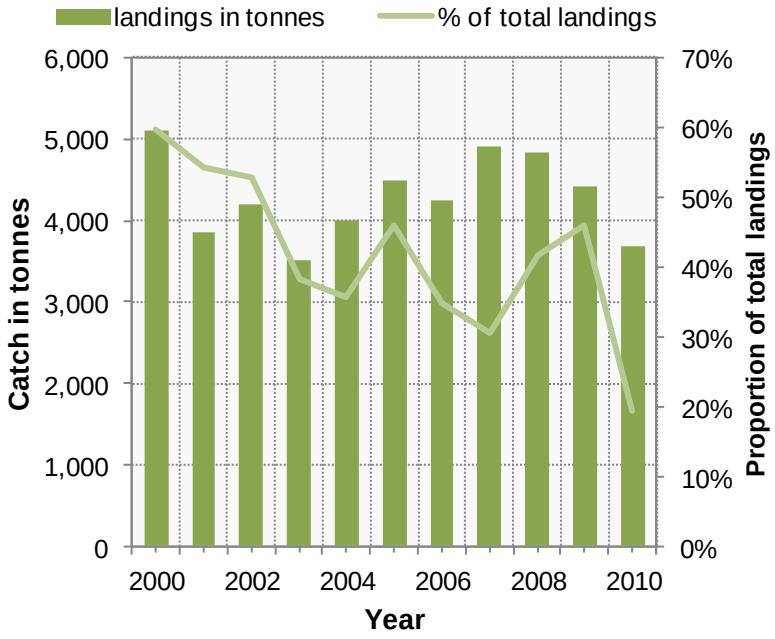

Figure 6. Annual landings of bottom longline and handline in the Azores for the period 2000-2010.

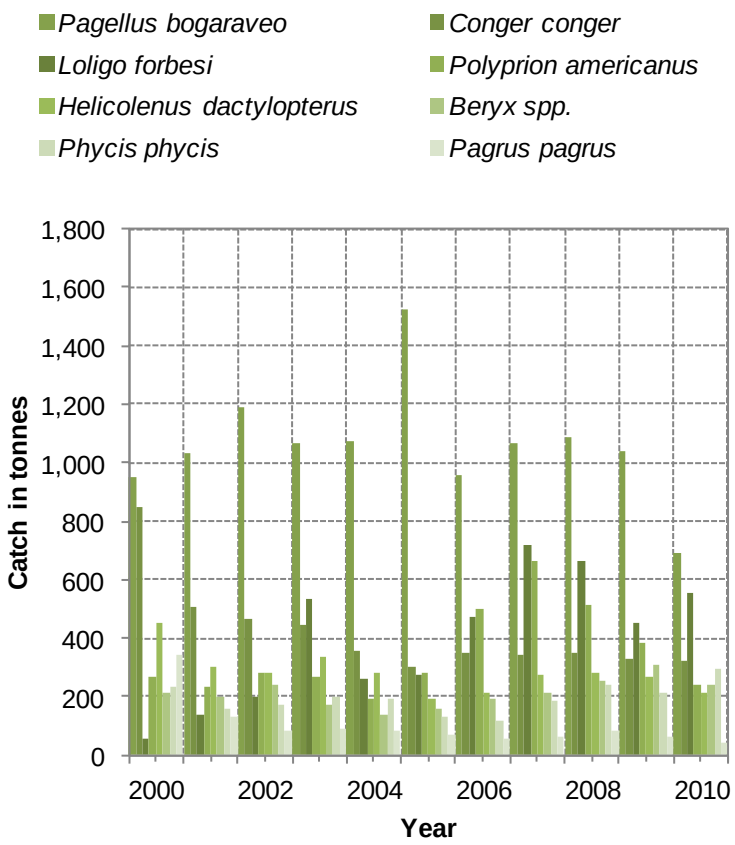

Figure 7. Annual landings of main species caught in the bottom longline and handline in the Azores for the period 2000-2010.

Estimation of unreported catch in the bottom longline and handline fisheries has been recently made (Christopher Pham et al., unpub. data). From 2000 to 2010, yearly discards averaged about 14% of the reported landings. Total unreported catches from the bottom longline fishery averaged 600 tonnes per year. For this period, deep-water sharks were represented by at least 10 species and accounted for 16% of the discarded organisms. These species are never landed and accounted in average for 135 tonnes of total discarded amount per year. Other species with high discard amounts per year included the bluemouth rockfish and alfonsinos especially for years when the TAC has been exceeded and discards reached more than 40% of the reported catch.

Stock status

Some of the target species of the bottom longline and handline fisheries are deep-water species and thus should have their stock status assessed by the ICES Working Group on the

Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). No local assessments are available for the period 2000-2010. However, longline surveys have been conducted annually by the local University, during spring, covering the main areas of distribution of demersal species (the coast of the islands, and the main fishing banks and seamounts), with the primary objective of estimating fish abundance for stock assessment (Pinho, 2003). The survey has supplied information needed to estimate the relative abundance of commercially important deep-water species, from ICES Area X, based on the common assumption that catch rate (cpue) is proportional to species abundance (ICES, 2011a).

Recently, the ICES provided quantitative advice for data-limited stocks including the blackspot seabream (ICES, 2012a). For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted status quo catch. For blackspot seabream stock in the Azores the abundance is estimated to have decreased by more than 20% in 2007–2009 and 2010–2011 (ICES, 2012a). Additionally, considering that exploitation is unknown, ICES advised that catches should decrease by a further 20% as a precautionary buffer (ICES, 2012a). As the bottom longline fishery moves into new areas the fisheries cpue may not reflect abundance at population level.

Analysis of the survey abundance data also suggests that some traditional commercially important demersal or deep water species, like the alfonsinos (Silva and Pinho, 2007) or bluemouth rockfish (Perrota and Hernandez, 2005) are intensively exploited. However, survey results also show a very high annual variability in the abundance indices (Figure 8), which cannot be explained only as a result of fishing effects.

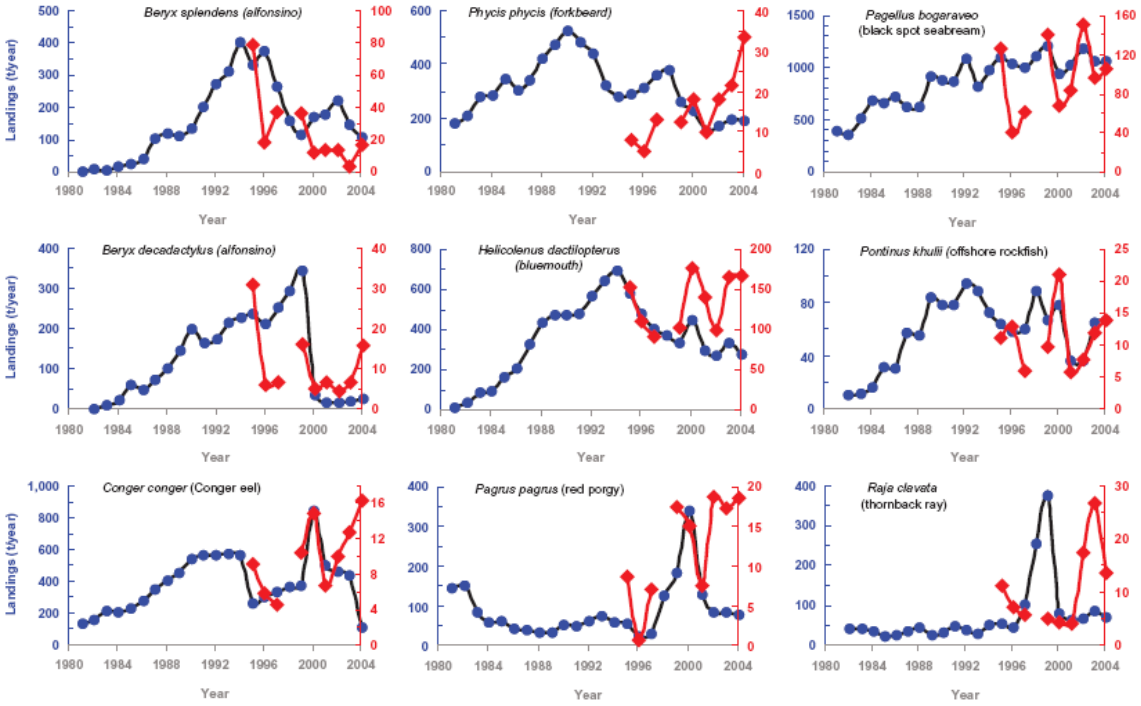

Figure 8. Annual landings (blue) and abundance indices (red) of some commercial demersal species (RPN: Relative Population Number from the Azorean Spring bottom longline survey) (adapted from Pinho and Menezes, 2006; and Silva and Pinho, 2007).

Although stock assessment methods and abundance indices show somehow healthy stocks of demersal deep water species in the Azores, there's a common perception among fishermen that some stock may be facing serious problems. Additionally, local fishers fear that open access regime under the current CFP reforms will allow foreign vessels to decimate their fish stocks (Carvalho et al., 2011). They argue that they are an ultra-remote island community, with fragile resources and economies and many rural communities heavily dependent on the fishing sector for their economic wellbeing (Carvalho et al., 2011). They need special recognition and special protection from the threats of open access and free-for-all fishing, which would encourage over-exploitation of fish stocks. Additional, there are some concerns on the potential exploitation of demersal fish stocks outside the Azores EEZ by international trawlers.

Economic and social performances

The bottom longline and handline fishing is by far the most valuable in terms of landed value. Data available from the Azores Regional Service for Statistics (SREA, http://estatistica.azores.gov.pt) for the period 2000-2010 indicates that the annual landed value of this fishery varied from 18 to 29 million Euros (Figure 9). The average price per kilo of demersal species remained stable for the whole period at about 5.3 Euros. Although bottom longline and handline catch represented in average 42% of all landed weight their landed value for this period averaged 76% of all landed value in the Azores. According to Carvalho et al. (2011) the bottom longline fisheries directly employed in 2005 about 350 crew members while the handline fishing about 930 fishermen, representing about 60% of all professional fishermen in the Azores. If the estimated crew members and averaged annual landed value are correct than this fisheries will have an average ratio of 17.6 thousand Euros per crew member per year.

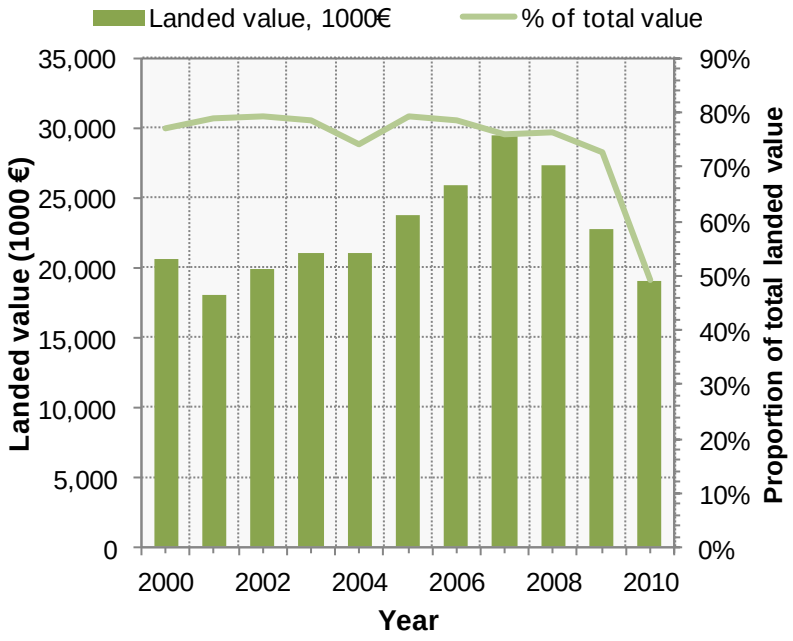

Figure 9. Landed value (1000€) of the bottom longline and handline fishing fleet in the Azores (data from SREA). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

Deep-water sharks are common discarded species in the bottom longline fisheries in the Azores, although in small quantities (Christopher Pham et al., unpub. data). They are represented by at least 10 species and are never landed. Estimated annual catch of these species by the longline fleets should be around 135 tonnes. Silva et al. (2011) found that cetaceans were recorded in the vicinity of the longline gear in 5% of all the sets monitored. Bottlenose dolphins (*Tursiops truncatus*), Risso's dolphins (*Grampus griseus*) and killer whales (*Orcinus orca*) and common dolphins (*Delphinus delphis*) were the most commonly seem species. Cetaceans were responsible for damaging the fish catch in less than 1% of the longline sets but no cetaceans were captured in any of the observed longline sets (Silva et al., 2011).

Effects of fisheries on natural habitats

It is well established that deep-sea trawling has dramatic impacts on the deep-sea, with damages analogous to forest clear cutting (Watling and Norse, 1998). Other techniques such as longlines have been suggested to be less harmful to the environment (Chuenpagdee et al., 2003). A recent report (Christopher Pham et al., unpub. data) showed that handline fishing for bottom species had no impact on sessile organisms. On the other hand, a typical longline set in the Azores had an expected bycatch of 1.23 sessile organisms or 0.96 cold-water corals (0.48kg ±0.16) much smaller than the expected bycatch of a bottom trawler operating in the Flemish Cap towing over the same area (37-59 kg; Murillo et al., 2011). Primary bycatch was composed of more than 79 different taxa belonging to 4 different phyla (Cnidaria, Bryozoa, Foraminifera and Porifera). Cold-Water-Corals (term that comprises Anthozoans and Hydrozoans) represented 74% of the bycatch, whilst sponges represented 19% and rocks and foraminifera the remaining 8%. Bycatch was found to be higher between 200 and 450 m depth and on seamounts when compared to island shelves. Analysis of video footage suggested that additional impacts were found in the sea bed with some cold water corals being seriously impacted by bottom longlines. A typical longline set in the Azores has an expected *in situ* impact of 9.6-14.5 CWC, but these numbers still need further validation. Longline have a selective impact on mostly 3-dimensional and branched colonies (Sampaio et al., 2012) which may alter benthic community structure. Even though the impact of bottom longlining may be significantly lower than that of other fishing gears such as bottom trawl, it

still may affect some of the oldest continuously living organisms on the planet such *Leiopathes* sp. and thus deserving some attention.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Pelagic Longline

Fisheries

Fishing techniques

The pelagic longline is defined as a series of baited hooks regularly attached to mainline suspended from buoys close to the sea surface. Longlines can be many kilometres long and carry thousands of hooks. The surface longline is very effective in catching swordfish and blue shark. The most common gear used in the Azores is the Spanish type (Ferreira et al., 2011), which consists of a multifilament mainline on which 11 m branch lines are attached successively with hooks at a fixed distance of 45 m (Figure 10). Fishing campaigns of the larger vessels can last for about a month from May/June to December. These large vessels deploy an average of 2500 hooks per set and extend their fishing areas outside the Exclusive Economic Zone (EEZ) of the Azores (Ferreira et al., 2001).

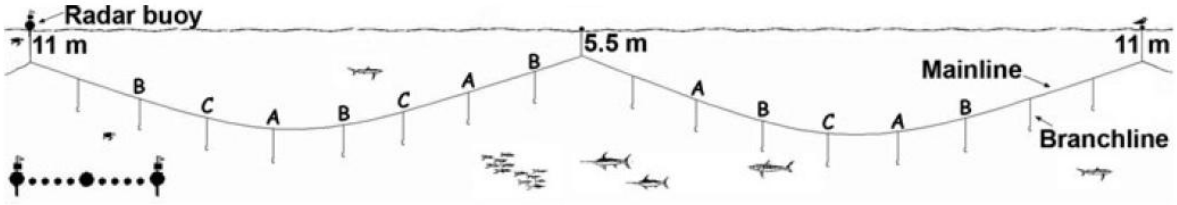

Figure 10. Schematic representation of the pelagic bottom longline gear used in the Azores (adapted from Ferreira et al., 2011).

Fishing fleet

The local pelagic longline fishing fleet in the Azores is quite small. According to Carvalho et al. (2011) there are about 5 pelagic longliners: 4 vessels of length between 12-20 m, and 1 vessel of length between 20-30 m. However, several vessels from mainland Portugal, Madeira or the European Union, usually fish in the Azores EEZ. According to a recent study on VMS data analyses (Morato, unpub. data), there must be around 30 pelagic longliners from mainland Portugal and 1 from Madeira Islands operating in the Azores waters. Spanish longliners returned to the Azores waters in 2004, when European vessels were allowed to fish 100 miles off the Azores, through the Western Waters Regulation, under the Common Fisheries Policy (Reg. EC Nº 1954/2003). The number of EU vessels operating in the Azores waters may be between 35 and 45.

Fish species and yields

The pelagic longline fleet operating in the Azores region traditionally targets swordfish was first introduced in the Azores in 1987 (Pereira, 1988a). Other species frequently caught by the longline fleet include blue sharks (*Prionace glauca*) and short-fin mako sharks (*Isurus oxyrinchus*). Other pelagic fish are occasionally caught but never exceeds 1% of the total catch. For recent years, observers' data reported that swordfish catches represent ~20% of the total catch (Vandeperre, personal communication); i.e a typical longline set with about 1,000 hooks would catch on average 0.44 tonnes of swordfish, 1.18 tonnes of blue shark and 0.04 tonnes of shortfin mako shark. Total landings in the Azores of the pelagic longline fleet for the period 2000 to 2010 averaged 150 t, ranging from about 90 t in 2008 to 233 in 2000 (Figure 11). The annual contribution of this fleet to the total landings in the Azores is averaged about 1.5%. Catch in the Azores but landed elsewhere averaged 1,500 t (Christopher Pham et al., unpub. data), varying from 700t in 2001 to 2,400t in 2007 (Figure 11). Reported annual landed values averaged 110t for blue sharks, 30t for swordfish and about 12t for mako shark. Annual landings outside of the Azores (Christopher Pham et al., unpub. data) may average 1,200t for blue sharks, 260t for swordfish and about 60t for mako shark (Figure 12).

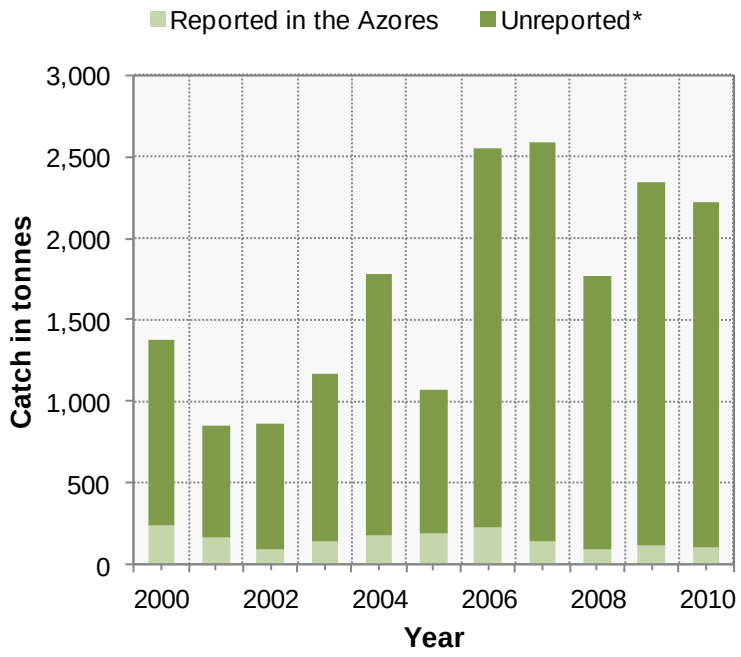

Figure 11. Total annual landings for the pelagic longline fleet operating in the Azores between 2000 and 2010. Reported catch, means fish landed in the Azores. Unreported catch means estimated catches by foreign and local fleets landing outside of the Azores. * cannot be considered truly unreported because some should enter fisheries statistics elsewhere.

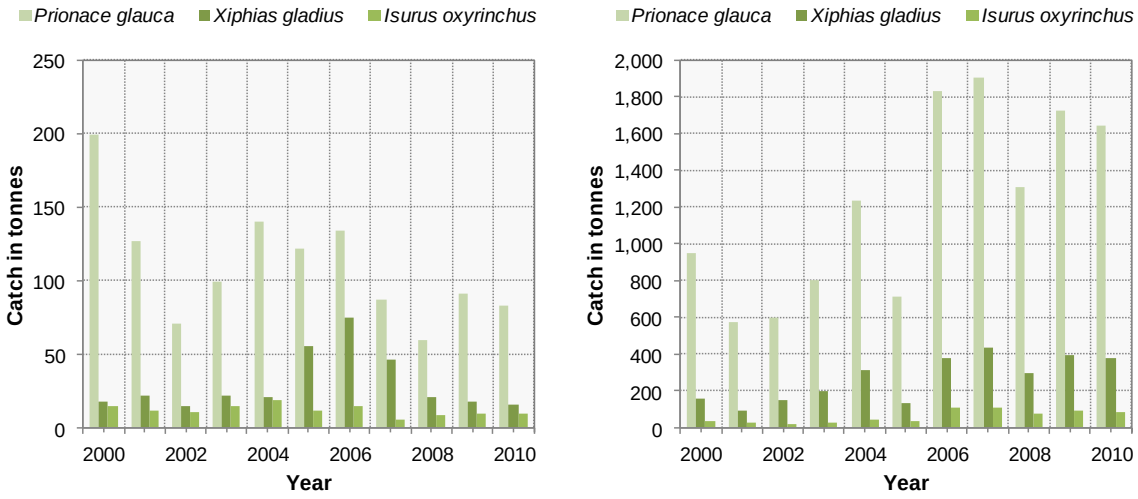

Figure 12. Annual landings for the main species caught in pelagic longline operating in the Azores between 2000 and 2010. Left panel, show reported catch, i.e. fish landed in the Azores. Right panel show the estimated unreported catch, i.e. catches by foreign and local fleets landing outside of the Azores which cannot be considered truly unreported because some should enter fisheries statistics elsewhere.

Stock status

There are no specific stock assessments for swordfish or blue shark in the Azores. These assessments have been conducted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The swordfish and blue shark stocks fished in the Azores are assessed as part of the Atlantic stock. The last assessment for Atlantic swordfish was conducted in 2009. For the past decade, the North Atlantic estimated catch has averaged about 11,500 t per year (ICCAT, 2012). The catch in 2010 represented a 40% decrease since the 1987 peak in North Atlantic landings. These reduced landings have been attributed to ICCAT regulatory recommendations and shifts in fleet distributions, including the movement of some vessels in certain years to the South Atlantic or out of the Atlantic (ICCAT, 2012). In addition, some fleets, including at least the United States, EU-Spain, EU-Portugal and Canada, have changed operating procedures to opportunistically target tuna and/or sharks, taking advantage of market conditions and higher relative catch rates of these species previously considered as by-catch in some fleets. The 2011 Swordfish Species Group reviewed new information from Canada, which provided updated age and sex-specific nominal catch rate series for its pelagic longline fishery for the period from 2002 to 2011. The trend in CPUE indicates that relative abundance has continued to increase since the series low in 2006 and is near the historical high observed in 1990 (ICCAT, 2012). The current results indicate that the stock is at or above BMSY and that the Commission's rebuilding objective has been achieved. However, since 2003 the catches have been below the TAC's greatly increasing the chances for a fast recovery (ICCAT, 2012).

The status of the stocks of blue shark and shortfin mako were last assessed in 2008. Ecological risk assessments for priority species of sharks caught in ICCAT fisheries demonstrated that most Atlantic pelagic sharks have exceptionally limited biological productivity and, as such, can be overfished even at very low levels of fishing mortality (ICCAT, 2012). For both North and South Atlantic blue shark stocks biomass is believed to be above the biomass that would support MSY and current harvest levels below FMSY (ICCAT, 2012). Estimates of stock status for the North Atlantic shortfin mako indicated stock depletion to about 50% of biomass estimated for the 1950s. There is a non-negligible probability that the North Atlantic shortfin mako stock could be below the biomass that could support MSY (ICCAT, 2012).

Economic and social performances

Annual landings of pelagic longline fleet are low as it is direct the revenue (Figure 13). The average annual landed value for the period 2000-2010 is about 0.7 million Euros while the maximum annual landed value was 1.0 million Euros, representing less than 2.5% of the total landed value in the Azores (Figure 13). The average price per kilo for the 2 main species was about 4.3 Euros. According to Carvalho et al. (2011) there were about 34 fishermen involved in the pelagic longline fishing based in the Azores, representing about 1.6% of all professional fishermen in the Azores. If the estimated crew members and averaged annual landed value are correct than this fisheries will have an average ratio of 1.9 thousand Euros per crew member per year.

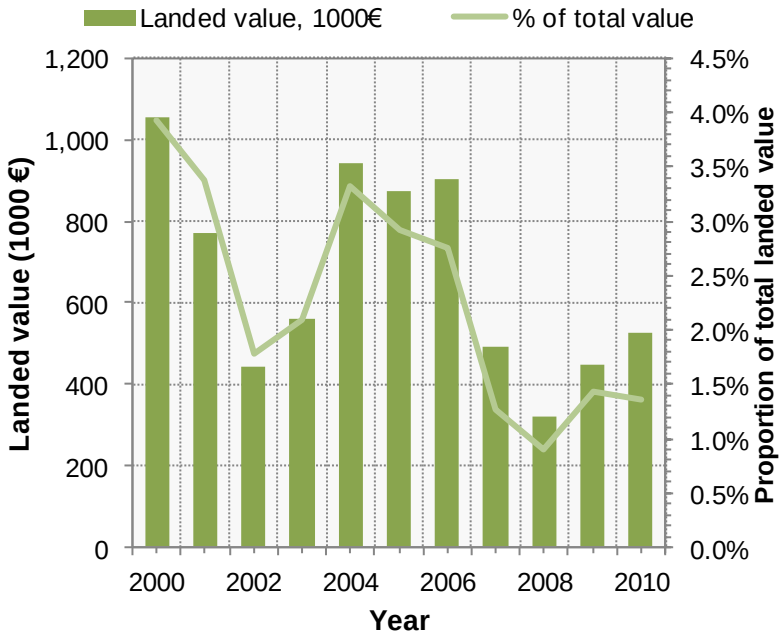

Figure 13. Landed value (1000€) of the pelagic longline fleet landing in the Azores (data from SREA). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

Average of unreported sharks catch for the Azorean fleet landing in the Azores for the period 2000-2010 was estimated to be about 208 tonnes per year (203 tonnes of blue shark, 5 tonnes of short-fin mako shark), whilst mean official shark catches were reported to be 73 tonnes per year. Between 2000 and 2010, the Azorean fleet landing outside the Azores was

estimated to catch an additional 447 tonnes per year of pelagic sharks. The mainland Portugal based fleet landed in the Azores only 44 tonnes of sharks (shortfin mako and blue shark) whilst 11,793 t might have been landed outside (Christopher Pham et al., unpub. data). The EU fleet might have capture about 1,000t of pelagic sharks per year.

Total biomass of marine turtles killed as a result of bycatch of the Azores fleet was estimated to average about 7.0 tons per year while the Portugal mainland fleet will add in average 3.3 tonnes per year, and the EU fleet about 8.8 tonnes per year (Christopher Pham et al., unpub. data). Bycatch of loggerhead turtles (*Caretta caretta*) were estimated assuming a mean number of turtles per fishing set of 1.4 (Marco Santos, unpublished data) and an individual weight of 19.8 kg (Bjorndal, Bolten and Martins, unpublished data). These estimates are slightly higher than those reported by Ferreira et al. (2001) but were obtained from a longer period, covering more longliners and considered more realistic. Not all sea turtles caught by pelagic longline fleet die but no estimates of hooked loggerhead mortality after gear removal are available for the Azores. Christopher Pham et al. (unpub. data) adopted a mortality level of 30% (Lewison et al., 2004) which was considered as the most appropriate for the local fishery (Marco Santos, personal communication). The impact of longline fishing on sea turtles in the Azores could be diminished through the regulation of the blue shark fishery (Ferreira et al., 2001; Aires-da-Silva et al., 2008). Ferreira et al. (2011) suggested mitigation measures to reduce turtle by-catch in the Azores, including policy that requires vessels to move away from fishing areas after high catch rates of turtles, longline fishing ban in aggregation areas, and selected gear modifications.

Effects of fisheries on natural habitats

Since this gear has no contact with the sea bottom it is not expected that pelagic longline will have any effects on natural habitats.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Pole and Line

Fisheries

Fishing techniques

Pole and line tuna fishery is one of the most important fisheries in the Azores with reported landings of about 14,000 tonnes in 2010 (Figure 14). The importance of this fishery to the total catch is highly variable from year to year, possibly due to changes in tuna abundance and in migration routes (Morato et al., 2001). The tuna fishing generally concentrates around the islands, especially around the central and eastern groups of the archipelago, and around offshore seamounts (Silva et al., 2002; Dâmaso, 2007; Morato et al., 2008b). All tuna fishing vessels operating in the Azores use pole-and-line, usually with live bait and water spray. The fishery usually lasts from April to October, the period when the tuna migrate through the region. A pole and line fishing trip lasts on average 5–6 days (Silva et al., 2002). The fishing activity starts in the early morning, with fishermen searching for tuna schools with binoculars and using seabirds or floating objects as sighting cues. Upon encountering a school, the water spray is activated and the live bait is thrown into the water to attract the tunas. Small pelagic fishes may sometimes be used to bait the hooks (Dâmaso, 2007). The number of fishing events per day varies greatly depending on the tuna abundance and size of the schools encountered. The duration of a fishing event and the number of fishing poles (or lines) used were found to be highly variable and poorly correlated with the total tuna caught (Silva et al., 2002). Successful fishing events may last up to 16 h but the average duration is about 25min (Silva et al., 2011).

Baitfish is captured by the tuna vessels themselves, using small purse seines or lift nets depending on the seasons/species. Silva et al. (2011) state that blue jack mackerel are mainly caught with purse seine nets that are 250 m long and 10–15 m in depth with a mesh size of 30–40 mm. Generally, fishing for blue jack mackerel occurs at night in 6 to 30 metres of water using lights and chum, while fishing for sardine occurs during the day in 2 to 20 metres of water. On occasion bait catches are made in the open ocean.

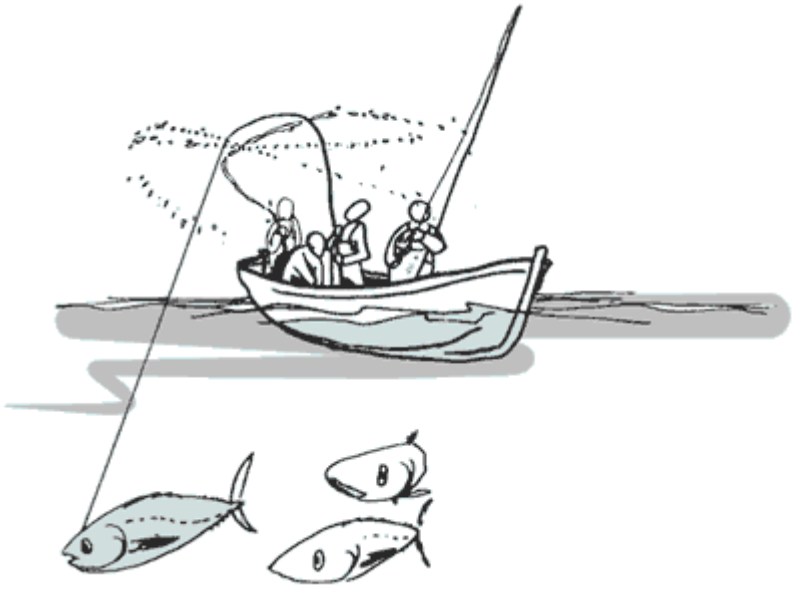

Figure 14. Drawing exemplifying the pole and line fishing techniques for tuna species (downloaded from http://www.pescas.net/artespescas.php).

Fishing fleet

According to Carvalho et al. (2011) there are about 29 pole and line fishing vessels of different sizes operating in the Azores: 6 vessels of length between 8-12 m, 2 of length between 12-20 m, 15 vessels of length between 20-30 m and 6 vessels of length greater than 30m. However, only those 21 fishing vessels greater than 20 m are usually considered as the true pole and line boats. The other smaller vessels may occasional operate during the summer when tuna abundances are high.

Fish species and yields

Five species of tuna are captured in the Azores: bigeye (*Thunnus obesus*), skipjack (*Katsuwonus pelamis*), albacore (*T. alalunga*), yellowfin tuna (*T. albacares*) and bluefin tuna (*T. thynnus*). Total annual landings of tuna (Figure 15) are high variable and ranged from about 2,000 tonnes in 2000 (21% of all landings) to about 14,000 in 2010 (72% of all landings). Likewise, catch of individuals species are quite variable (Figure 15). Skipjack and bigeye are by far the most captured species, accounting for about 95% of total tuna landings in weight (Dâmaso, 2007). Annual catches of albacore (recent maximum of 340 tonnes in 2008), yellowfin tuna (last reported landing of 1 tonne in 1989) and bluefin tuna (recent maximum of 1.1 tonnes in 2007) are in general low.

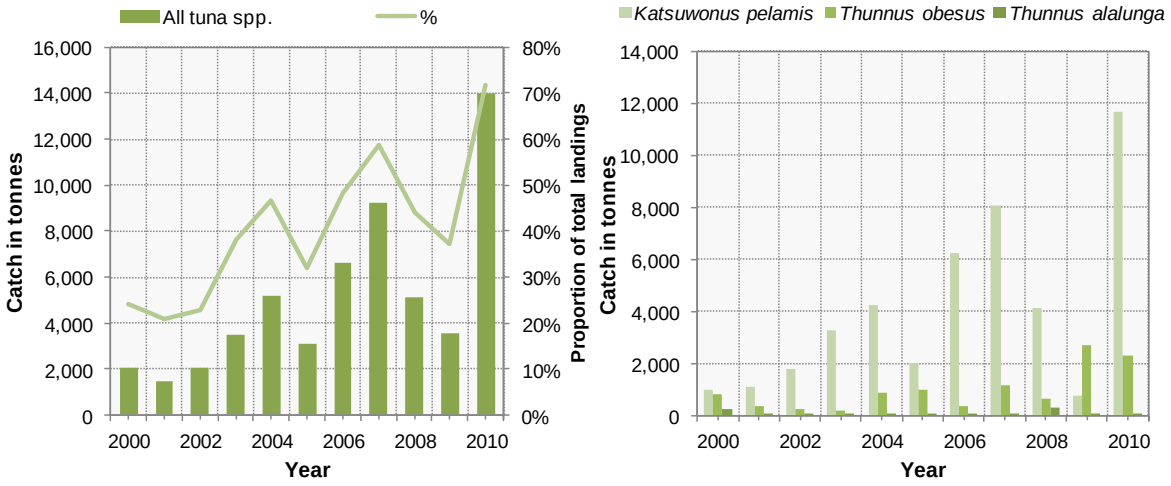

Figure 15. Annual landings of all tuna species (left) and main tuna species (right) in the Azores for the period 2000-2010.

The amount of baitfish used by the pole-and-line fishery is not reported to local authorities, remaining largely unknown and unmanaged. Some of the baitfish species are also targeted by other small scale fisheries. This is mostly true for blue jack mackerel that are caught with small purse seines set from small boats (see small pelagics). A recent study (Christopher Pham et al., pers. comm.) estimated an overall tuna to baitfish ratio of 21:1, well within the ratio reported for pole-and-line fishing operations in the Pacific (Gillett, 2011). Estimates of catches of baitfish for tuna pole-and-line fishing for the period 2000-2010 averaged about 190 tonnes, representing between 2.7% and 31.7% of the officially reported catch for small-pelagic species. In average, the two major species of baitfish were sardines (*Sardina pilchardus*, 46%) and blue jack mackerel (45%) (Figure 16). The remaining fraction (9%) included the juvenile blackspot seabream, chub mackerel, bogue (*Boops boops*), boarfish (*Capros aper*) and longspine snipefish (*Macroramphosus scolopax*).

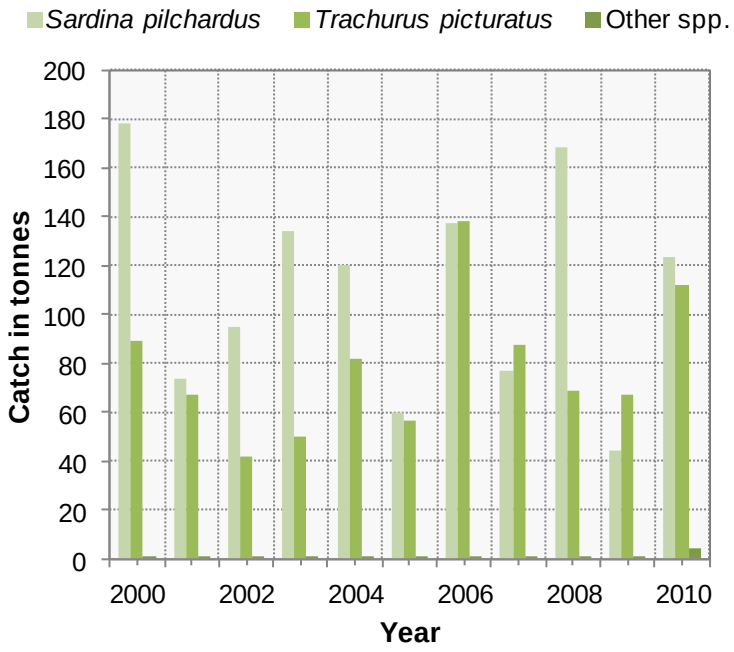

Figure 16. Total baitfish catch by the pole-and-line tuna fishing fleet in the Azores for the period 2000-2010. Other species includes blackspot seabream, chub mackerel, bogue, boarfish and longspine snipe fish.

A recent independent report on the management of tuna bait fisheries (Gillett, 2012) suggested that there are currently few, if any, "hot management issues" dealing with the bait fishery in the Azores. In the recent past there was an issue over catches of juvenile blackspot seabream in the bait fishery because this species as an adult is a main target in the demersal fishery. This issue has largely been resolved with a ban on the catching of juvenile blackspot seabream.

Stock status

There are no specific stock assessments for tuna species in the Azores. These assessments have been conducted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The tuna stocks fished in the Azores are assessed in conjunction of all Eastern Atlantic stocks.

Stock assessments for eastern Atlantic skipjack were conducted in 2008 (Anon. 2009) using available catches to 2006. ICCAT analyzed mostly two standardized indices from the EU-purse seine fishery but also stated that no marked trend has been observed for the Canary

Islands pole and line as well as for a peripheral fishery such as the Azorean pole and line fishery (ICCAT, 2012). While caution is needed, the main conclusion of the report is that it is unlikely that skipjack tuna be over exploited in the eastern Atlantic. There is currently no specific regulation in effect for skipjack tuna and ICCAT makes no management recommendations for this species.

The last stock assessment for bigeye tuna was conducted under the ICCAT in 2010 (ICCAT, 2012). The assessment includes data for selected longline fleets and the Azores pole and line fleet. Historical estimates for the entire Atlantic show large declines in biomass and increases in fishing mortality. In the last five or six years there have been possible increases in biomass and declines in fishing mortality. Current recommendations ask for a reduction of the TAC to 85,000 t to promote stock growth (ICCAT, 2012). Concern over the catch of small bigeye tuna partially led to the establishment of spatial closures to surface fishing gear in the Gulf of Guinea (ICCAT, 2012).

The status of the North Atlantic albacore stock is based on the most recent analyses conducted in 2009 (ICCAT, 2012). North Atlantic stock is exploited by surface fisheries targeting mainly immature and sub-adult fish (50 cm to 90 cm FL) and longline fisheries targeting immature and adult albacore (60 cm to 130 cm FL). The main surface fisheries are carried out by EU fleets in the Bay of Biscay, in the adjacent waters of the northeast Atlantic and in the vicinity of the Canary and Azores Islands in summer and autumn (ICCAT, 2012). The CPUE trends for the various surface fleets, showed somewhat different patterns, but for the longline fleets, the general trend in CPUE indices is a decline over time. Based on the most recent assessment, the albacore stock status is that spawning stock size has declined and in 2007 was about one third of the peak. In 2009, the Commission established a new TAC for 2010 and 2011 of 28,000 t (ICCAT, 2012).

Economic and social performances

Annual landings of tuna species are highly variable as is its economic importance. Data available from the Azores Regional Service for Statistics (SREA, http://estatistica.azores.gov.pt) for the period 2000-2010 indicates that the annual landed value of the pole and line fleet varied from 1.5 to 16.5 million Euros, reflecting the annual fluctuation in the catch (Figure 17). The average price per kilo of tuna remained stable for the whole period at about 1 Euros with a tendency for a slight increase in recent years. Although tuna catch represented from 20% to 70% of all landed weight their landed value varied from 7% to 40% of all landed value in the Azores. The pole and line fleet directly employed in

2005 about 365 crew members (Carvalho et al., 2011), representing about 17% of all professional fishermen in the Azores. The number of indirect jobs generated by tuna fishing activity, mostly workers at tuna canning factories, is not easily accessible. Crew are usually paid their share of the captures at the end of the fishing season, which generally lasts from March to October. During the off-season, most of the tuna fleet crew work in the canning factories, earning about the minimum wage. If the estimated crew members and averaged annual landed value are correct than this fisheries will have an average ratio of 13 thousand Euros per crew member per year.

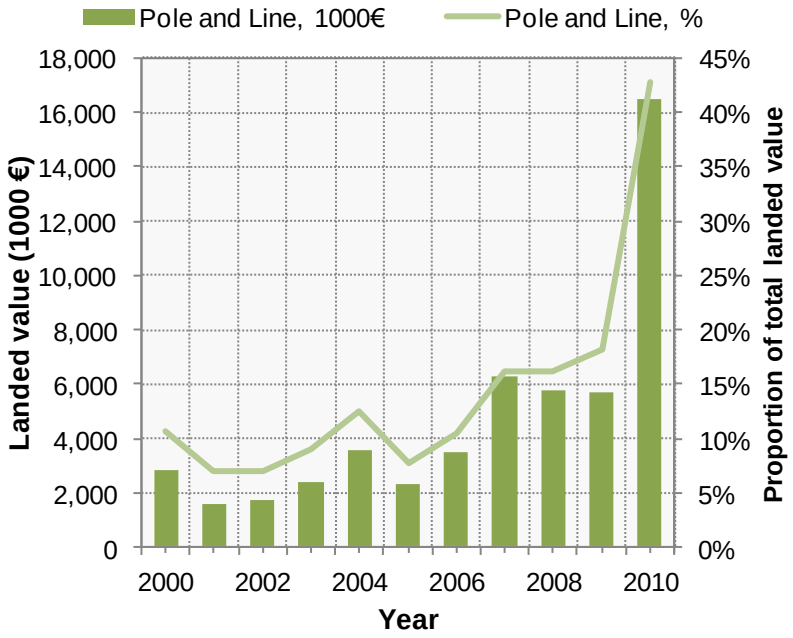

Figure 17. Landed value (1000€) of tuna species mainly caught by the pole and line fishing fleet in the Azores (data from SREA). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

The pole and line fishing it's an extremely selective fishery and there were no reports of bycatch of any sort including cetaceans (Silva et al., 2011).

Effects of fisheries on natural habitats

Since this gear has no contact with the sea bottom it is not expected that pole and line will have any effects on natural habitats.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Small pelagics

Fisheries

Fishing techniques

One of the most important fisheries in the Azores is the small pelagic fishery targeting young blue jack mackerel, chub mackerel and to a lesser extent the sardine. The blue jack mackerel has traditionally been one of the favourite species for human consumption in the Azores and is targeted by an artisanal fleet using seine nets close to the coast of the Azorean islands (ICES, 2011b). Traditionally, this fishery operates with small-scale and manually operated purse seine, lift nets or hand nets (Figure 18). Additionally, small pelagic species are also the main species used as live bait by the local bait boat fleet, which targets tuna species (see pole and line fishing). The demersal fleet also catches adults of both blue jack and chub mackerel, in the bottom longline fishery.

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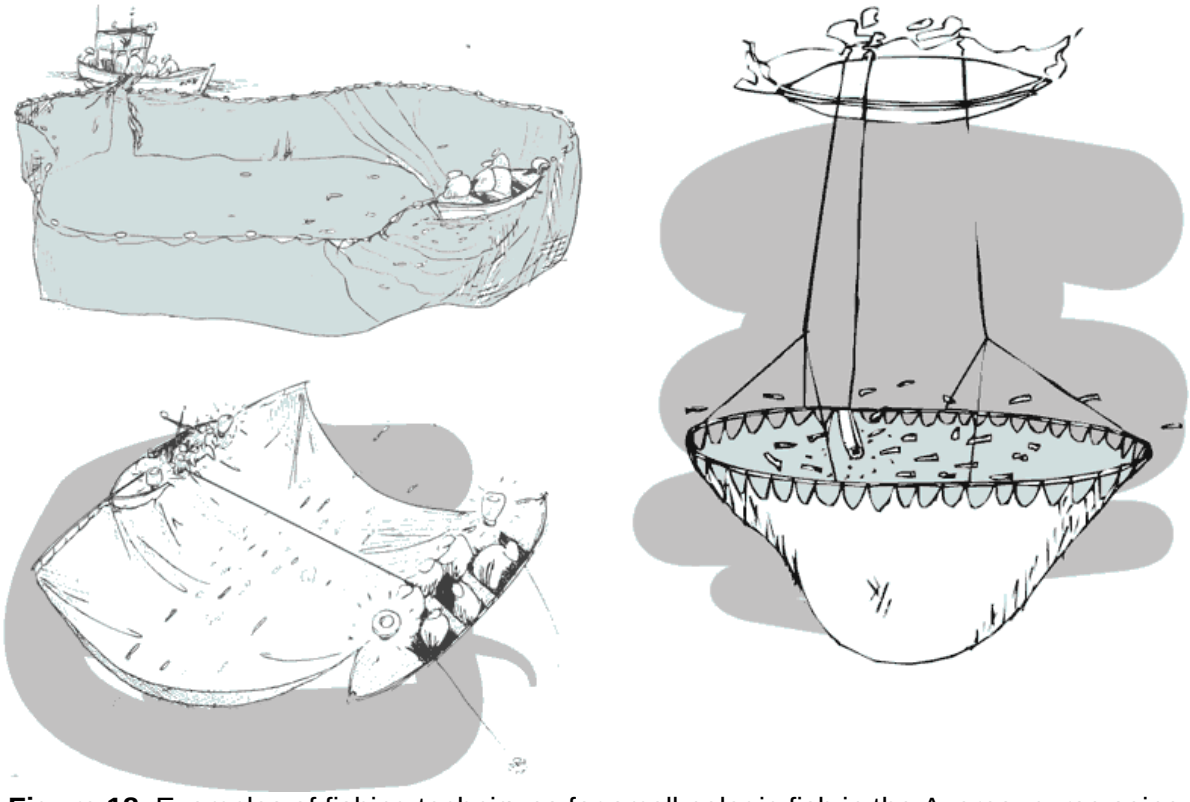

Figure 18. Examples of fishing techniques for small pelagic fish in the Azores: purse seine, lift nets and hand nets (downloaded from http://www.pescas.net/artespescas.php).

Fishing fleet

According to Carvalho et al. (2011) there are about 23 vessels involved in the small scale fishing in the Azores. All vessels are smaller than 12m in length.

Fish species and yields

The small pelagic fishery using nets target small blue jack mackerel, chub mackerel and sardine. Other species are occasionally caught in this fisheries namely bogue. Annual landings of this fishery average about 1.4 million tonnes (Figure 19). In the last 11 years, annual landings varied from about 1.0 to 1.8 million tonnes, representing about 15% of all landings in the Azores. The blue jack mackerel is by far the most important species with annual landings averaging about 1 million tonne (Figure 19). Chub mackerel and sardine have smaller annual landings of about 320 and 80 tonnes, respectively.

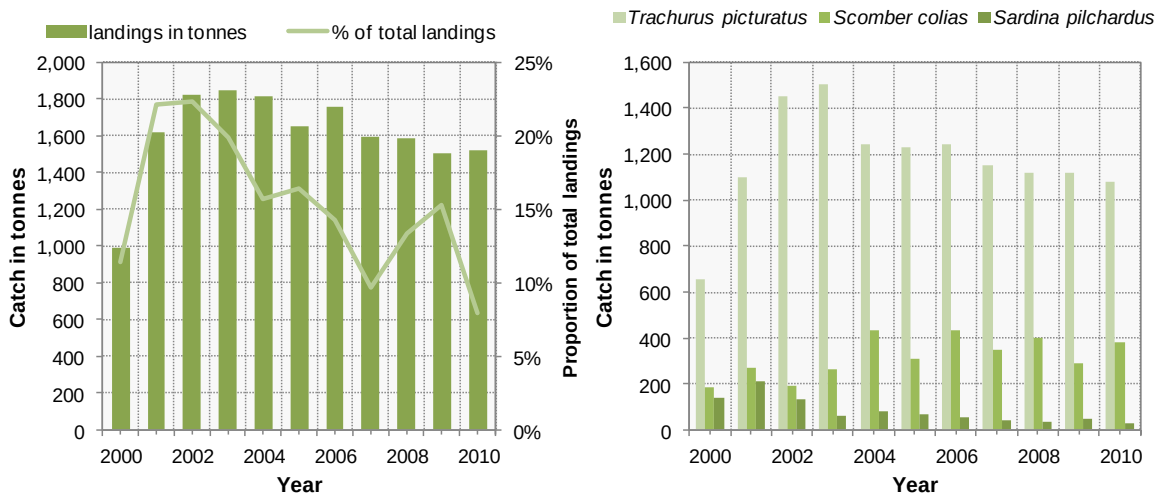

Figure 19. Annual landings of the small pelagic fisheries using surrounding nets (left) and main fish species (right) in the Azores for the period 2000-2010.

Stock status

In general, there is the feeling among fisheries stakeholders that small pelagics in the Azores area are a fairly resilient resource (Gillett, 2012). Recently, the ICES Working Group on Southern Horse Mackerel, Anchovy and Sardine (WGHANSA) conducted the first analyses for blue jack mackerel in the waters of the Azores (ICES, 2012b) and the first quantitative advice for this stock (ICES, 2012b). The landing per unit effort indices show increasing trends, but the exploitation status is unknown, therefore on the basis of precautionary considerations, ICES recommended that catches should not be allowed to increase (ICES 2011b). The working group showed that the available information shows an increasing trend in abundance indices over the last ten years. The group also mentioned that landings per unit effort should be interpreted with caution, since discards, fish used for bait or fish caught in the baitfish fisheries are not accounted for. The stability of the catches may be due to a continuous decline in consumer demands lead to the catch limits adopted by the fleet and an auto regulation regime adopted by the fisherman association (ICES 2011b).

Economic and social performances

Although annual landings of the small pelagic fisheries averaged 15% of all landings, its value averaged 7% of all landed value in the Region (Figure 20). Total annual landed value for the period 2000-2010 ranged from 1.7 to 2.7 million Euros, while the average price per kilo of all small pelagic species averaged 1.4 Euros. The small scale fishing for small pelagic may have employed about 162 crew members in 2005 (Carvalho et al., 2011), representing

about 7.5% of all professional fishermen in the Azores. If the estimated crew members and averaged annual landed value are correct than this fisheries will have an average ratio of 13.6 thousand Euros per crew member per year, similar to the pole and line fishing.

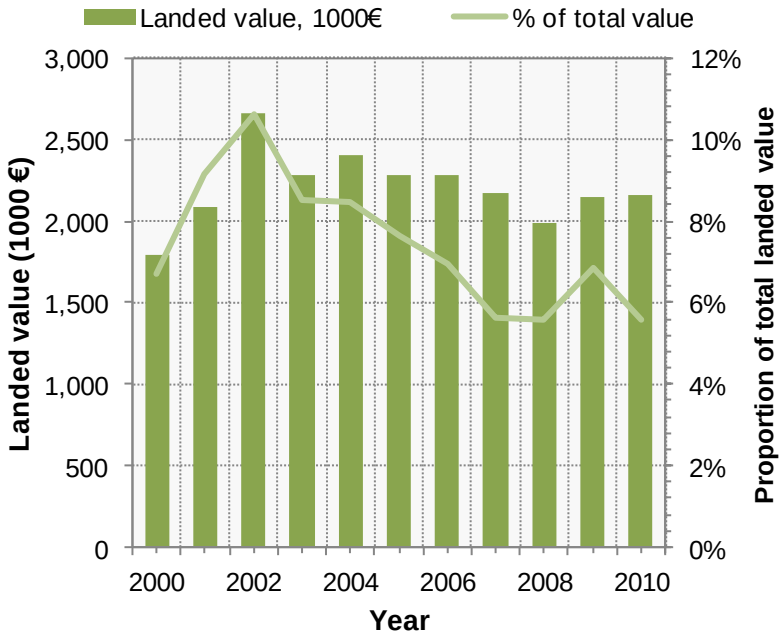

Figure 20. Landed value (1000€) of small pelagic fisheries using surrounding nets in the Azores (data from SREA). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

No reports on bycatch of sensitive species were found in the literature. Silva et al. (2011) studied the interaction of cetaceans with different fishing gears and found that for the small pelagic fishery cetaceans' species, mainly common dolphins, interacted with the fishery in 1.6% of the observed events. However, there was no mortality of cetaceans associated with this fishery.

Effects of fisheries on natural habitats

No descriptions on the effects of small pelagic fisheries using surroundings nets fisheries on natural habitats were found in the literature. To our no major effects of this fishery on natural habitats are expected.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Drifting deep-water longline

Fisheries

Fishing techniques

Drifting deep-water longline usually consists in a main line connected to several perpendicular vertical lines (free lines) generally 900m (±100m) long with a buoy attached to the upper end (Figure 21). The main line drifts above the bottom fishing at different distances from the seabed which ranges from 1000 to 1900 m depth. Mustad hooks number 5 are usually used connected to main line trough 3.5 m length leaders (or gangions). The average number of hooks per set in the Azores is 3600 while the mean soak time is 10 hours.

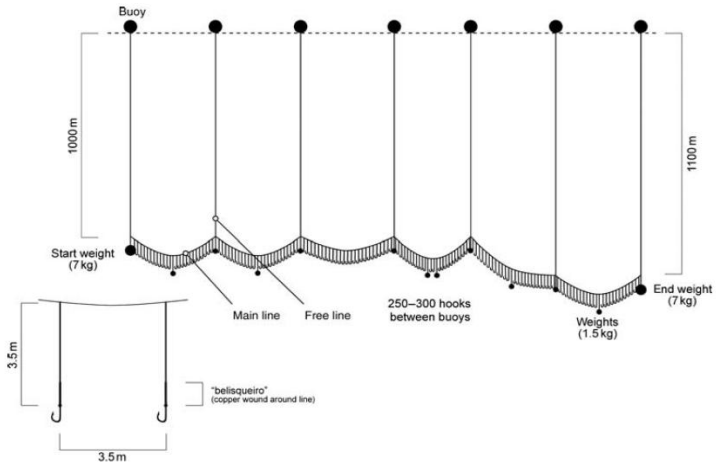

Figure 21. Sketch of the longline fishing gear used in the black scabbardfish experimental fisheries in the Azores (adapted from Machete et al., 2011).

Fishing fleet

The number of fishing vessels involved in commercial drifting deep-water longline in 2010 is unknown. According to a report prepared by seaExpert (2012) there are about 10 fishing vessels with a mean length of 14m operating the drifting deep-water longline in the Azores.

Fish species and yields

Drifting deep-water longline targets black scabbardfish. This fisheries is still in an experimental phase in the Azores and landings are small (Figure 22). In average, for the past 10 years yearly landings were around 50 tonnes (< 1% of total landings) with a peak in 2005 of about 320 tonnes (3.3% of total landings). By-catch estimated based on Machete et al. (2011) proportions have also been low with an estimated maximum of 16 tonnes (Figure 22).

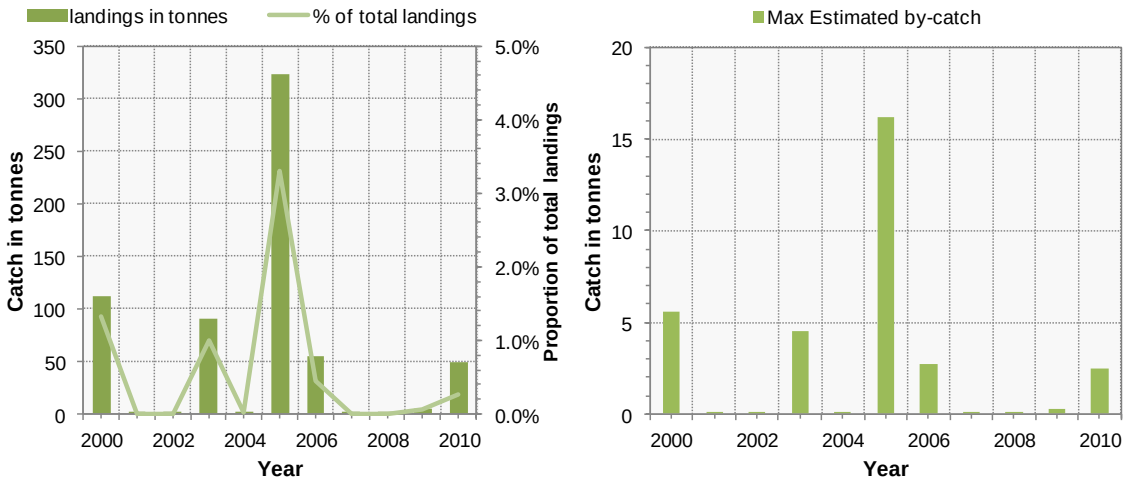

Figure 22. Annual landings (left) of black scabbardfish in the Azores for the period 2000-2010 and maximum estimated by-catch (right).

Stock status

Currently, black scabbardfish has been increasingly targeted by the Portuguese, French and Irish fishing fleets in the Northeast Atlantic (Gordon et al., 2003; Large et al., 2003; ICES, 2006; Bordalo-Machado and Figueiredo, 2009). This species may show a relatively fast growth for a deep-water fish, with maturation occurring at an age of 3 to 4 years (100 cm total length) and a longevity ranging from 12 to 24 years (Morales-Nin and Sena-Carvalho, 1996; Morales-Nin et al., 2002). Despite the insufficient and inconclusive information about the biology and life history of this species some indicators suggested that abundances are

declining in some areas of the Northeast Atlantic (Lorance and Dupouy, 2001; ICES 2008), which motivated the implementation of TAC system in 2003 (ICES, 2011a).

Most of the Azores EEZ lies at ICES Division X where TAC for black scabbardfish have been approved in conjunction with areas VIII and IX. The Portuguese share of TAC was increased for 2013 and 2014 in 5% (3,477 t and 3,650 t, respectively). Despite the variability on the overall landings data along years, the landing data available for different ICES subareas give evidence that the areas of major concentration of the species is at ICES Division X (ICES, 2011a). In the Azores, the stock status of black scabbardfish is unknown; however, the resource is being regarded as a nearly virgin stock (Machete et al., 2011). The absence of a local market for this species and the complexity and labour requirements of the gear and operation have limited the development of the fishery in the Azores. Based on the experience from other black scabbardfish fisheries, Machete et al. (2011) suggested that fishing mortality should be maintained at a low level, traditional fishing methods should be encouraged, and close monitoring of by-catch species should be implemented.

Economic and social performances

Annual landings of black scabbardfish are extremely low as it is the revenue (Figure 23). The average annual landed value for the period 2000-2010 is about 0.1 million Euros (0.3% of the total) while the maximum annual landed value was 0.4 million Euros, representing less than 1.5% of the total landed value in the Azores (Figure 23). The average price per kilo of black scabbardfish remained extremely low at about 2.2 Euros. There's no information about the number of fishermen involved in the drifting deep-water longline. If we consider an average of 10 crew members per vessel and 10 vessels operating in the Azores, then the estimated number of direct jobs would be about 100 (approximately 4.5% of all fishermen in the Azores). If the estimated crew members and averaged annual landed value are correct than this fisheries will have an average ratio of 0.8 thousand Euros per crew member per year.

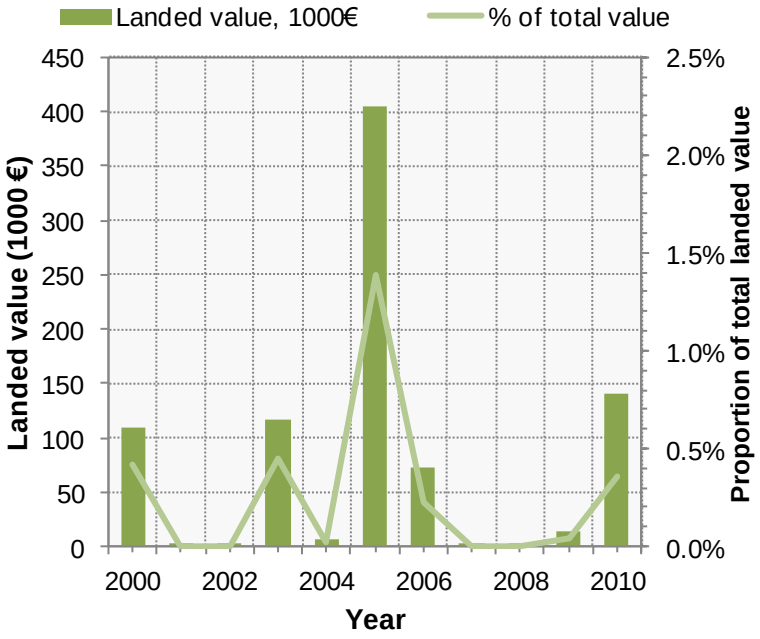

Figure 23. Landed value (1000€) of black scabbardfish caught by the drifting deep-water longline fishing fleet in the Azores (data from SREA). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

By-catch associated with longline fishing gears are usually regarded of conservation concern (Yokota et al., 2006). Machete et al. (2011) found by-catch values varying between 3% and 5% of the black scabbardfish catch, similar to those observed for other longline fisheries such as in Madeira or mainland Portugal (Martins and Ferreira, 1995; Bordalo-Machado and Figueiredo, 2009) but smaller to those observed in the deep-water trawl fishery targeting black scabbardfish (Anon, 2002). A recent report (seaExpert, 2012), however, estimated a much higher by-catch of deep water sharks than that reported in Machete et al. (2011). In the Azores as in other regions, deep sea sharks (mainly leafscale gulper shark, *C. squamosus* and the Portuguese dogfish, *Centroscymnus* sp.) composed the main by catch (Machete et al., 2011). Other species reported as by-catch of the drifting deep-water longline targeting black scabbardfish but with low numbers include *Etmopterus* sp., *Mora moro*, *Deania* cf. *Calcea*, *Centroselachus crepidater*, *Alepochepalus rostratus*, *Deania profundorum* and *Chiasmodon niger*. There is a growing concern with the bycatch of some of these species but despite low catch records, Machete et al. (2011) suggested that those catches should be

closely monitored in the future if the fishery is to be expanded in the Azores. There were no reports of cetacean or marine turtles capture, presence or interference in this fishery (Silva et al., 2011).

Effects of fisheries on natural habitats

No major effects of drifting deep-water longline fisheries on natural habitats have been found in the literature. Since this gear has no contact with the sea bottom it is not expected that drifting deep-water longline will have major effects on natural habitats.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Other fisheries

Traps and costal net fisheries

Traps and coastal net fisheries are a small component of the artisanal fisheries in the Azores. No information on the number of fishermen involved or catch for the period 2000-2010 was found in the literature. The most common species caught in the coastal net fishing are parrotfish (*Sparisoma cretense*), grey mullet (*Chelon labrosus*), Atlantic bonito (*Sarda sarda*), yellowmouth barracuda (*Sphyraena viridensis*), pompano (*Trachinotus ovatus*), white seabream (*Diplodus sargus*) and salema (*Sarpa salpa*). Traps are being used both for invertebrates and fish but data on their catch composition or catch amounts were not found in the literature.

Trawling

In 2001, one large bottom trawler from the company S. Macário Indústria de Pescas was allowed to undertake an experimental fishery for orange roughy (*Hoplostethus atlanticus*)

within the Azores EEZ (Melo and Menezes, 2002). Total catch from the experimental fishery for orange roughy (2001-2002) summed up to 403 tonnes; 373 tonnes of orange roughy and 30 tonnes of other deep-water fish and shark species such as the black scabbardfish, the Risso's smooth head (*Alepocephalus rostratus*) and sleeper sharks *Somniosus microcephalus* and *Centroscymnus coelolepis* (Melo and Menezes, 2002). The experiment also revealed a significant level of bottom disturbance. After this experimental fishery the Government of the Azores decided to close large part of the EZZ to bottom trawling.

Between 1973 and 1977, Soviet Union undertook some fishery expeditions in various seamounts of the North East Atlantic using bottom trawls. Catch data from these vessels were reported by Vinnichenko (2002), with total estimated catch within the Azores of 6,300 tonnes (Christopher Pham et al., unpub. data). The main species were silver scabbardfish, blue jack mackerel, chub mackerel and alfonsinos. This value represents 32.5 % of the reported catch of the same species for those years. It is not expected that this activities are currently occurring around the EZZ of the Azores but it is a matter of concern for local fishermen and authorities.

Commercial harvesting of coastal invertebrates

A wide variety of small invertebrates are consumed by the local community, constituting an important resource for all the islands (Santos et al., 1995). The main invertebrate species includes the patellid limpets (*Patella candei* and *Patella aspera*), the common octopus (*Octopus vulgaris*), spiny lobster (*Palinurus elephas*), the giant barnacle (*Megabalanus azoricus*), the slipper lobster (*Scyllarides latus*) and some crabs (e.g. *Maja squinado* and *Grapsus grapsus*). With the exception of limpets in the 1980s, these species are not exported and are traditionally sold to local restaurants and household without entering official statistics (Ferraz et al., 2000). The total catch of this species is unknown since the large portion is not reported. A recent study (Christopher Pham et al., unpub. data) tried to estimate limpets and octopuses unreported catch. They concluded that the unreported component of the limpet catch was on average 60 times the amount reported in official statistics each year. Unreported catches of octopuses varied between 10 to 30 times the official statistics. They also stated that these values are probably still an underestimation.

Recreational fishing

The main recreational fishing activities in the Azores are spear-fishing, boat fishing, coastal rod fishing from shore and hand collecting (Diogo, 2007). A recent study (Christopher Pham et al., unpub. data) estimated the catch from the recreational sector to vary between 294 and 944 tonnes per year. The most important species in terms of volume are the white seabream with a total catch of 6,484 tonnes (222% of official statistics), the blacktail comber (*Serranus atricauda*) with a total catch of 4,709 tonnes (83% of official statistics), the chub mackerel with a total catch of 2,992 tonnes (14% of official statistics) and the parrotfish with a total catch of 2,967 tonnes (60% of official statistics).

Big game fishing

Game fishing for large pelagic fishes started in the mid 1980s (Pereira, 1988b) peaking in the 1990s with up to 8 boats registered on the island of Faial and is still active today. With the exception of one report briefly describing the activity from 1984 to 1987 (Pereira, 1988b), there is little data on total fish removal. In the early days, most of the blue marlin (*Makaira nigricans*) caught was landed but by 1989 big-game fishing became essentially a catch and release activity. For recent years, the total blue marlin mortality rarely exceeded 2 individuals per boat per year as only potential size records are landed. Total removal of and white marlin (*Tetrapturus albidus*) by the game fishing sector from 1984 to 2010 was estimated to sum up to 90 tonnes. ICCAT reports a maximum removal of 10 tonnes of blue marlin by the sport fishing sector in 1993, a value not present in local fisheries statistics. Our estimates suggest that for the past ten years, the average blue marlin mortality was 1.5 tonnes per year.

Fishery resources in the EEZ of Madeira

Drifting deep-water longline

Fisheries

Fishing techniques

The drifting deep-water longline in Madeira Islands is very specialized targeting the black scabbardfish. The fishing gear used in Madeira black scabbardfish fishery in the last few decades is a mid-water horizontal drifting longline, set in the water column usually at depths of 1000 m (Figure 24) (Bordalo-Machado et al., 2009). The number of hooks per set has increased from 4,000-5,000 (Merrett and Haedrich, 1997) to an average of 7,000-8,000 hooks at present (Bordalo-Machado et al., 2009). Steel nº 6 hooks are used, usually baited with salted squid slices (*Ommastrephes sp*.) or filets of blue jack mackerel and chub mackerel (Bordalo-Machado et al., 2009). The fishing operations described by Merrett and Haedrich (1997) have remained almost unchanged to the present time. The number of fishing days per fishing trip increased from 2-3 in the 1990s (Reis et al., 2001) to 5-7 at present. This is apparently due to fishermen's recent endeavours to exploit more distant fishing grounds. The fleet now exploits new areas, especially located SE of Madeira, as far as 150-200 nautical miles from the fishing port (Bordalo-Machado et al., 2009). Madeira vessels conduct more than two hauls per fishing trip. In fact, the duration of fishing trips in Madeira waters has increased to five or more days in the last years, reflecting a search for more distant grounds to capture the species (Bordalo-Machado et al., 2009). The fishery is mostly developed inside the Madeira Exclusive Economic Zone, included in the CECAF 34.1.2 area, all year round. Sporadically fishing sets are made, by the vessels with superior autonomy, in the vicinity of the Madeira EEZ.

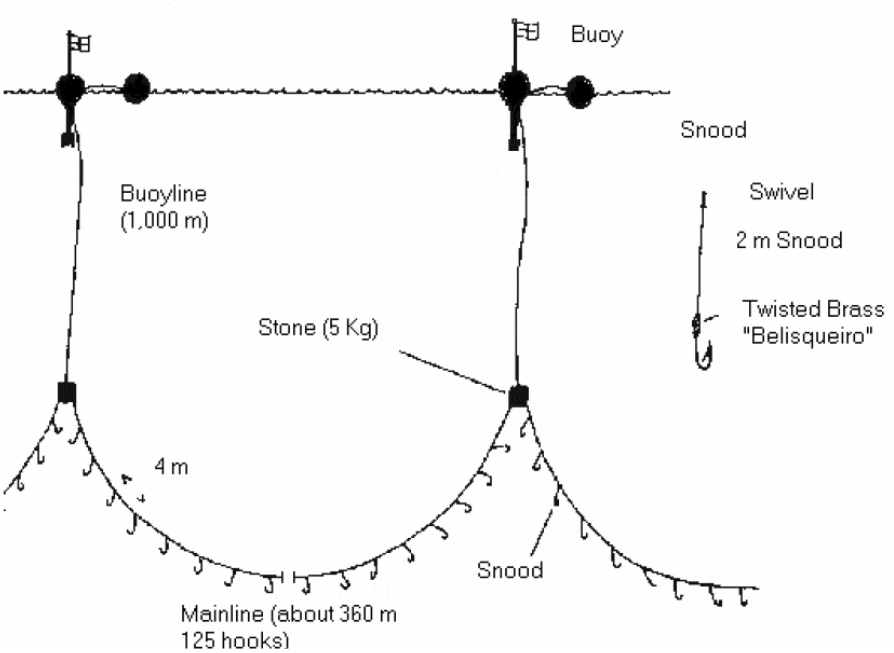

Figure 24. Schematic representation of the drifting deep-water longline gear used in the black scabbardfish fisheries Madeira (adapted from Reis et al., 2001).

Fishing fleet

The black scabbardfish is reported in Madeira Island since 1600. The Madeira traditional deepwater fishery is one of the more interesting and long standing examples. It probably started in the early 1800's when local fisherman were targeting "oil fish" (Noronha, 1925). In that time, the fleet was already composed by 30 vessels. The fleet was constituted mainly by small artisanal vessels (<6m length) and a lower engine power compared with the mainland Portugal fleet vessels. The number of vessels dedicated to this fishery peaked in 1988 with a total of 95 vessels. After that period the fleet suffer a considerable reduction, mainly between 1990 and 1995, when the number of vessels dropped from 84 to 44 (Bordalo-Machado et al., 2009). Between 1998 and 2000, the fleet comprised ca. 40 vessels (on average 13 m LOA, 19 GT and 150 Hp) (Reis et al., 2001). Fleet size continued to decrease to around 15 vessels in the most recent years (2009-2010), with no significant changes in their technical characteristics.

Fish species and yields

Drifting deep-water longline targeting black scabbardfish is the main fishery activity in Madeira Islands. Not surprisingly, annual catches represent in average 48% of all landings in

Madeira (Figure 25). However, landings of black scabbardfish is steadily declining in Madeira Islands since 1998, continuing declining during the period from 2000 to 2010. During these last years total landings varied from 4.2 thousand tonnes in 2000 to 1.8 thousand tonnes in 2010. By-catch of the Madeira fisheries may compose 2-15% of the black scabbardfish catch, but its species composition was not described in the literature.

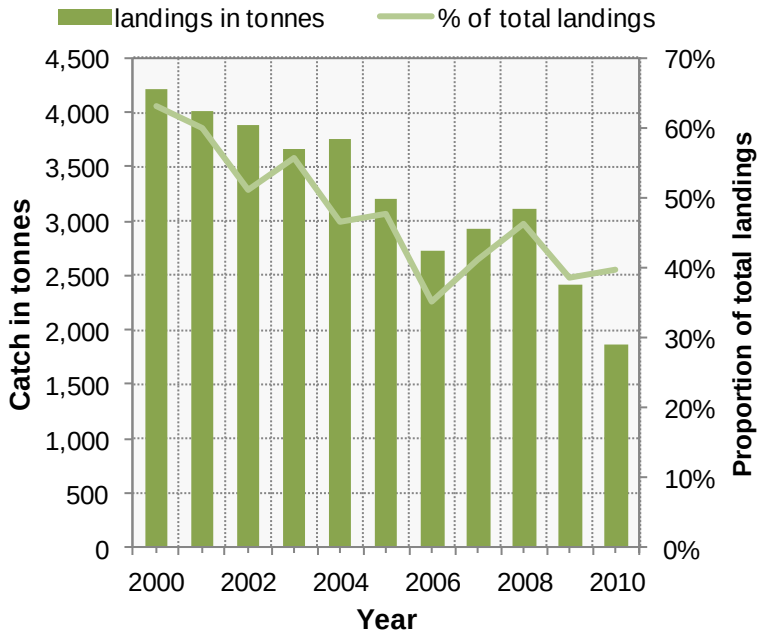

Figure 25. Annual landings of black scabbardfish (*Aphanopus carbo*) in Madeira archipelago for the period 2000-2010.

Stock status

The black scabbardfish is presently one of the most important commercial deep-water resources dealt with by the ICES Working Group in the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). Despite the research progress made on some aspects of the species biology and related fisheries, there is still a great lack of scientific evidence to support the currently assumed hypothesis of a single stock in the north-eastern Atlantic (Figueiredo et al., 2003; ICES, 2006). For assessment purposes the WGDEEP considers a north component that comprises the multi-species trawl fisheries operating in sub-areas VI and VII and a south component that includes the longline fishery of mainland Portugal in division IXa (ICES, 2001a). In effect, it is known that the species experiences different exploitation regimes within the north-eastern Atlantic and shows differences in its length structure between northern and southern regions (Bordalo-Machado et al., 2009).

Based on the decline in the abundance of the stock of black scabbardfish in Northern Europe fishing areas, WGDEEP suggested that fishing effort should be reduced significantly (ICES, 2006). This conclusions lead to the introduction in 2003 of management measures, based on fishing licenses and a TAC enforcement. In subarea CECAF 34.1.2, were Madeira is inserted, TAC suffered its first cuts in 2011, with a reduction from 4,285 to 4,071 tonnes. In the same subarea, for the year of 2012, the TAC was established on 3,867 tonnes.

Economic and social performances

Annual landings of black scabbardfish are declining since late 1990's but annual landed value remained almost the same (Figure 26). This reflects the fact that the price per kilo of black scabbardfish has increased from about 1.6 Euros in 2000 to about 2.9 Euros in 2010. The average annual landed value for the period 2000-2010 is about 6.8 million Euros, representing 51% of the total landed value. The number of crew members involved in this fishery was difficult to assess, but may be around 250 sea crew members plus about 200 land crew members.

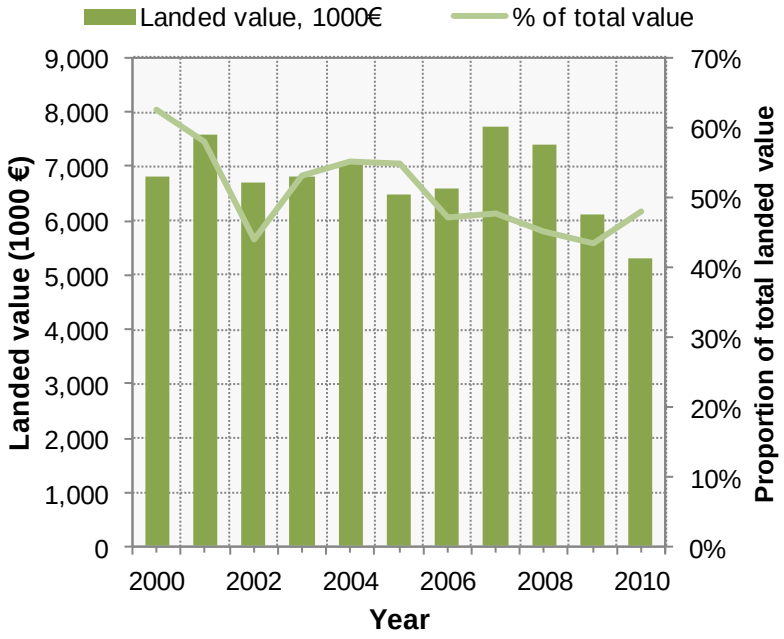

Figure 26. Landed value (1000€) of black scabbardfish caught by the drifting deep-water longline fishing fleet in Madeira. The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

Despite being considered a highly selected gear, the longline black scabbardfish fishery has the potential to capture other deep-water species, mainly deep-water sharks. The discard rates are known to be low with some species of deep water sharks being landed in Maderia. However, a zero TAC for deep-water sharks since 2008 may potentially lead to increased discarding. Accurate discards rates and species composition is well known for the Azores (Machete et al., 2011) and Mainland Portugal (Bordalo-Machado et al., 2009) but not known for the Madeira fleet.

Effects of fisheries on natural habitats

No major effects of drifting deep-water longline fisheries on natural habitats has been found in the literature. Since this gear has no contact with the sea bottom it is not expected that drifting deep-water longline will have major effects on natural habitats.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Pole and line

Fisheries

Fishing techniques

The pole and line fishing in Madeira islands targets large pelagic fishes, namely tuna species such as bigeye tuna and skipjack. The fishery uses live bait and is mostly developed inside the Madeira Exclusive Economic Zone, included in the CECAF 34.1.2 area. The bait boat fishery targeting the bigeye and the skipjack tuna carried out by this fleet is seasonal and sequential in nature (Gouveia et al., 2001). The fishing gear consists of a pole and a line with a hook on it. The dimensions of the hook vary, depending on the size and species to be

fished. The tuna schools are searched visually. After a school is detected, it is attracted and retained close to the boat with the aid of the live bait and sea water sprays. This hides the poles and the shadows of the boat and simulates a school of small fish on the surface. The fishing season of the bigeye tuna runs preferably from March to July, with maximum values occurring around the month of May. For skipjack tuna the season usually begins after the bigeye fishery and is highly variable (Gouveia and Mejuto, 2003). Common fishing grounds are located around the South coast of Madeira, Desertas and Porto Santo islands. However, important fleet displacements occurred towards Selvagens islands (160 nautical miles South) or Seine seamount (135 nautical miles Northeast) (Gouveia et al., 2001).

Baitfish is captured by the tuna vessels themselves, using small purse seines or lift nets depending on the seasons/species. The bait is comprised basically of small pelagic species (blue jack mackerel, sardines or any other local species) that are kept alive on board the fishing boat in tanks with open sea water circuits (ICCAT, 2008).

Fishing fleet

This fishery comprises around 13 fishing vessels between the 12-18 and 18-24 m. In recent years it is observed that larger and well-equipped fishing boats are in operation, increasing the mobility of the fleet towards tuna schools, thus covering a wider area of the EEZ. The amount of small vessels that usually catch tuna changes each year, depending on the abundance of tuna schools near the seashore. Important displacements of the fleet to the Azores fishing area were noticed for some years. These fleet displacements around the Portuguese archipelagos (Azores and Madeira) are quite common for both fleets in recent years (Gouveia et al., 2001).

Fish species and yields

Two species compose the main catch of the pole and line fleet in Madeira Islands: bigeye and skipjack. Total annual landings of tuna (Figure 27) are high variable and ranged from about 700 tonnes in 2,000 (10% of all landings) to about 3,900 in 2006 (49% of all landings). The average landings from the pole and line fleet for the period 2000-2010 was 2,300 tonnes or 34% of the total landings in Madeira. The bigeye tuna was the most important species in the catch until the 1990s as well as in the most recent years (Gouveia and Mejuto, 2003). The skipjack was the most important species between 1991 and 1995. The decline in the

catches of both species in the most recent years of the time series available is a cause for alarm in the local fleet, and the reasons have not been clarified (Gouveia and Mejuto, 2003).

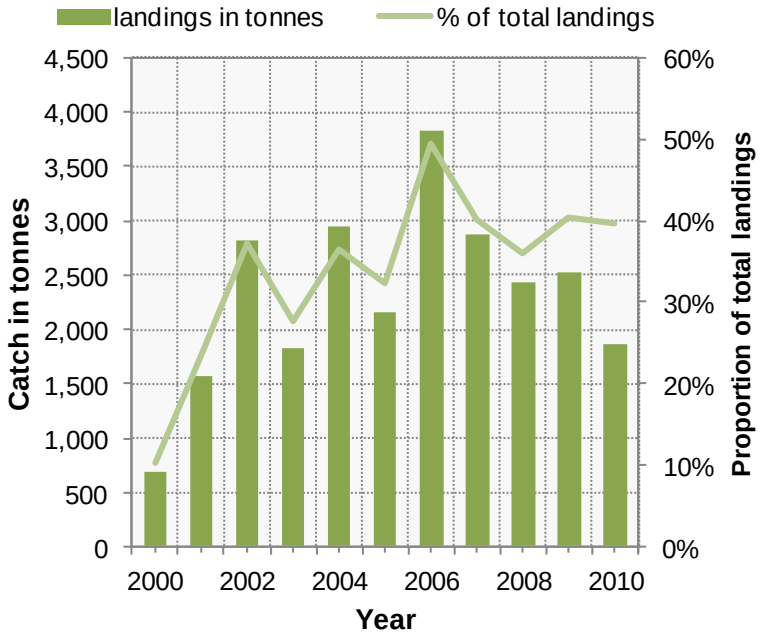

Figure 27. Annual landings of all tuna species caught in the Madeira pole and line fleet for the period 2000-2010.

Stock status

There are no specific stock assessments for tuna species in Madeira Islands. These assessments have been conducted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The tuna stocks fished in the Madeira (as the ones fished in the Azores) are assessed in conjunction of all Eastern Atlantic stocks. See pole and line section of the Azores for details on the stock status of Atlantic tuna species. While caution is needed, the main conclusion of the report is that it is unlikely that skipjack tuna be over exploited in the eastern Atlantic (ICCAT, 2012). For bigeye, there have been recently increases in biomass and declines in fishing mortality (ICCAT, 2012).

Economic and social performances

The tuna catch has been an important fishery resource in Madeira archipelago for a long time. Annual landings of tuna species are highly variable as is its economic importance. Data available from the Madeira Regional Service for Statistics (DREM, http://estatistica.gov-madeira.pt/) for the period 2000-2010 indicates that the annual landed value of the pole and

line fleet varied from 1.8 to 6.6 million Euros, reflecting the annual fluctuation in the catch and price per kilo (Figure 28). The economic value of the pole and line fleet varied from 16% to 44% of the total landed value in the Region; average for the period 2000-2010 of 34%. The average price per kilo of tuna fluctuated significantly between years from about 1.4 to 2.7 Euros, which may reflect differences in species composition of the catch. The number of crew members involved in this fishery was difficult to assess.

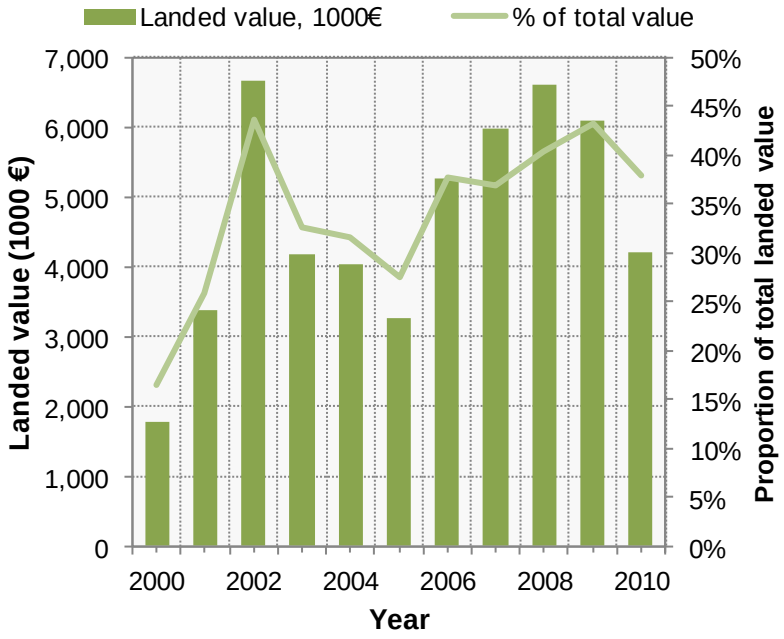

Figure 28. Landed value (1000€) of tuna species caught by the pole and line fishing fleet in Madeira. The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

As in the Azores, the pole and line fishing it's an extremely selective fishery and there were no reports of bycatch of any sort including cetaceans.

Effects of fisheries on natural habitats

Since this gear has no contact with the sea bottom it is not expected that pole and line will have any effects on natural habitats.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. Highly migratory species such as tuna are highly susceptible to the seasonal, inter-annual and inter-decadal variations of the oceanographic conditions (Gouveia and Mejuto, 2003). However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Small pelagics

Fisheries

Small pelagic fish, mostly blue jack mackerel and chub mackerel, are caught by a small coastal purse seine fleet that operates in general off the south coast of Madeira Island and occasionally off Desertas Islands (Vasconcelos et al., 2011). Fishing operations occur mostly during the night, using lights to attract fish (Vasconvelos et al., 2006). The fish are concentrated and attracted to the net by chumming which is made of a mixture of triturated raw fish, and by intense spotlights, a very efficient method to catch pelagic species (Vasconcelos et al., 2006).

Fishing fleet

From 2009 onwards, this fishery was comprised by only 3 vessels of the 18-24 m segment operating all year round. The number of smaller boats involved in the small pelagic fisheries should be substantially higher.

Fish species and yields

The small pelagic fishery target mainly small blue jack mackerel and chub mackerel. Other species are occasionally caught in this fisheries namely bogue and sardine. Annual landings of this fishery average about 870 thousand tonnes (Figure 29). In the last 11 years, annual landings varied from about 550 in 2010 to 1,500 thousand tonnes in 2000, representing about 13% of all landings in Madeira. While catches of chub mackerel were declining during the 2000-2010 period the blue jack mackerel catch have remained stable (Figure 29).

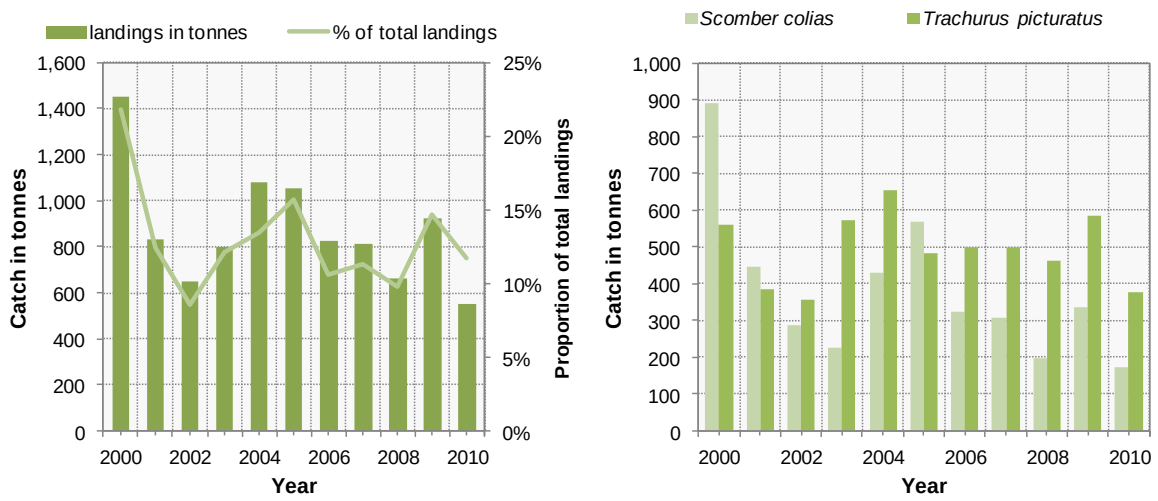

Figure 29. Annual landings of the small pelagic fisheries (left) and main fish species (right) in Madeira archipelago for the period 2000-2010.

Stock status

Despite being an important fishery resource in Madeira, information on the biology of this species in Madeira is relatively scarce (Vasconcelos et al., 2011). No specific and stock assessments or management plans are known for the target species of this fishery.

Economic and social performances

Although annual landings of the small pelagic fisheries averaged 13% of all landings, its value averaged 7.5% of all landed value in Madeira (Figure 30). Total annual landed value for the period 2000-2010 ranged from 0.6 to 1.3 million Euros, while the average price per kilo of all small pelagic species averaged 1.2 Euros. The number of crew members involved in this fishery was difficult to assess, but may be around 150.

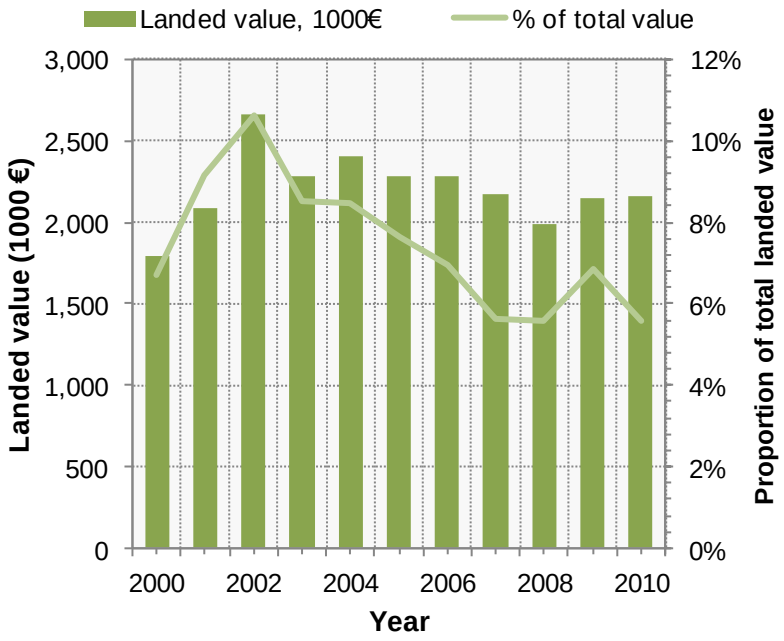

Figure 30. Landed value (1000€) of small pelagic fisheries using surrounding nets in Madeira. The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

No information is available to assess the bycatch of sensitive species in Madeira Islands small pelagic fleet.

Effects of fisheries on natural habitats

No descriptions on the effects of small pelagic fisheries using surroundings nets fisheries on natural habitats were found in the literature. To our no major effects of this fishery on natural habitats are expected.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Bottom Longline and handline

Fishing techniques

Very limited information on the bottom longline and handline fishery in Madeira Island is found in the literature. It is only known that this fleet operates around the Madeira and Porto Santo islands and occasionally off Desertas Island (Alves et al., 2011). It comprises a multispecific fishery targeting a large number of demersal species with high commercial value. No further description of the fishing gear or fishing techniques was found.

Fishing fleet

This fishery is operated all year round mostly by small vessels (<10 m) in the insular shelf (Anon., 2010). No further information on the fishing fleet operating with bottom longlines and handlines in Madeira Island was found in the literature.

Fish species and yields

The demersal species, although highly valorised, represents only a small portion of the unloading of fish caught by the fishing fleet (Alves et al., 2011). Annual landings of the bottom longline and handline fleet were estimated by adding the reported catch of fish species likely to have been caught with this gear. Average landings of the bottom longline and handline for the period 2000-2010 was extremely low and estimated to be around 50 t (Figure 31). Note that there's an average of 302 t per year of the official landings reported as other species and therefore, landings for bottom longline can potentially be much higher. Bottom longline and handline fisheries catch in Madeira include more than 20 demersal species but only few have important landings. The most important species for the period 2000-2010 (Figure 32) included the red porgy with average annual landings of 19 t, the forkbeard with about 11 t, the wreckfish with about 10 t, the blacktail comber with about 6 t per year, the blackspot seabream with average annual landings of 4 t, barracudas (*Sphyraena* sp.) with 2 t per year (DGRM, http://estatistica.gov-madeira.pt).

The most important demersal fish captured in Madeira is the red porgy that around 1997 saw its catch increased due to the capture bigger fish and to the presence of large adults of the pink dentex (*Dentex gibbosus*) (Alves and Delgado, 2002). The current catch of pink dentex are unknown but believed to be small.

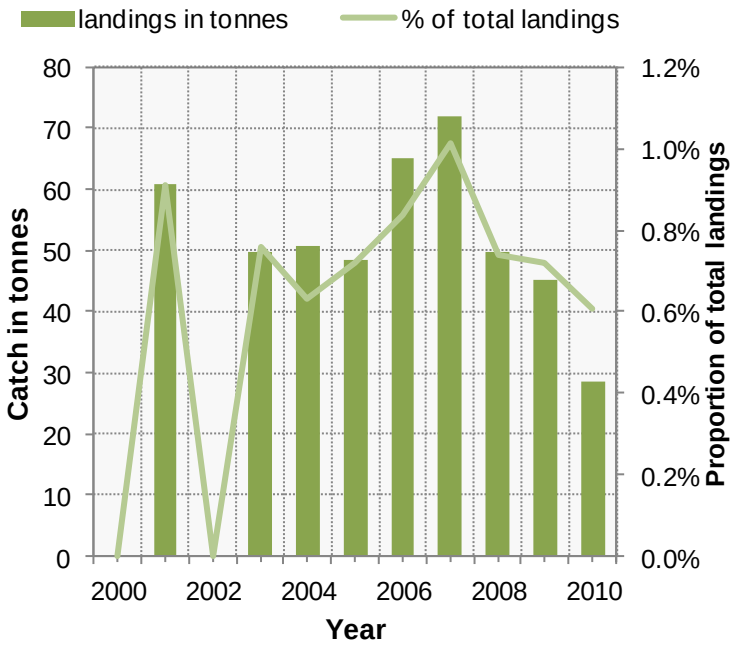

Figure 31. Annual landings of bottom longline and handline in the Madeira archipelago for the period 2000-2010.

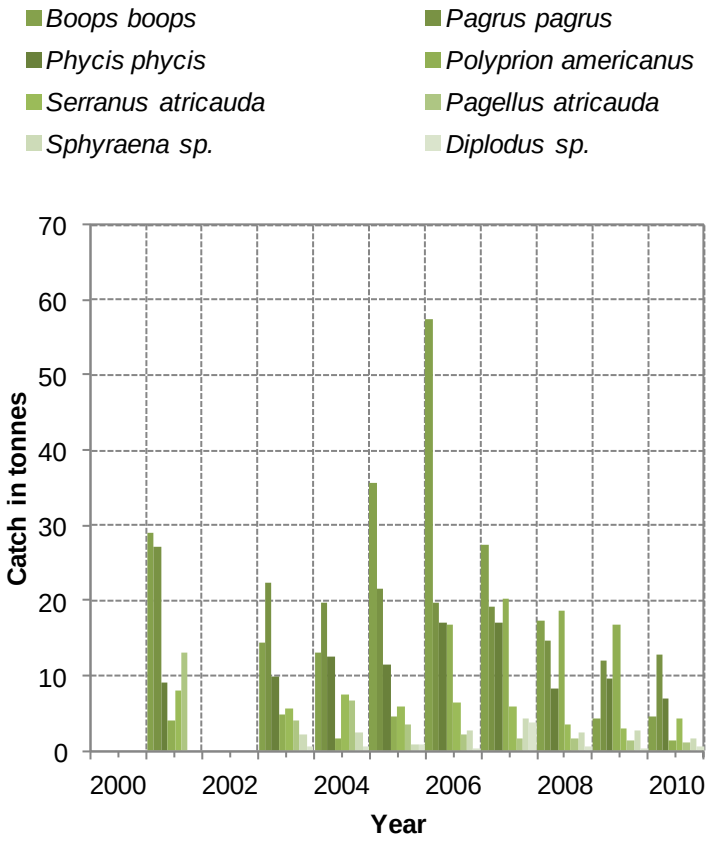

Figure 32. Annual landings of main species caught in the bottom longline and handline in Madeira archipelago for the period 2000-2010.

Stock status

The stock status for all the demersal fish species caught in Madeira is unknown.

Economic and social performances

The bottom longline and handline fishing in Madeira Islands is small activity in terms of landings (about 0.9% of all landings) and landed value. However, it has an important role in the socio-economic context of Madeira Island (Anon., 2010). Data available from the Madeira Regional Service for Statistics (DREM, http://estatistica.gov-madeira.pt/) for the period 2000-2010 indicates that the annual landed value of this fishery varied from 150 to about 500 thousand Euros (Figure 33), representing in average 2.2% of all landed value in Madeira. The average price per kilo of the target species remained stable for the whole period at about 5.1 Euros. The number of crew members involved in this fishery was difficult to assess.

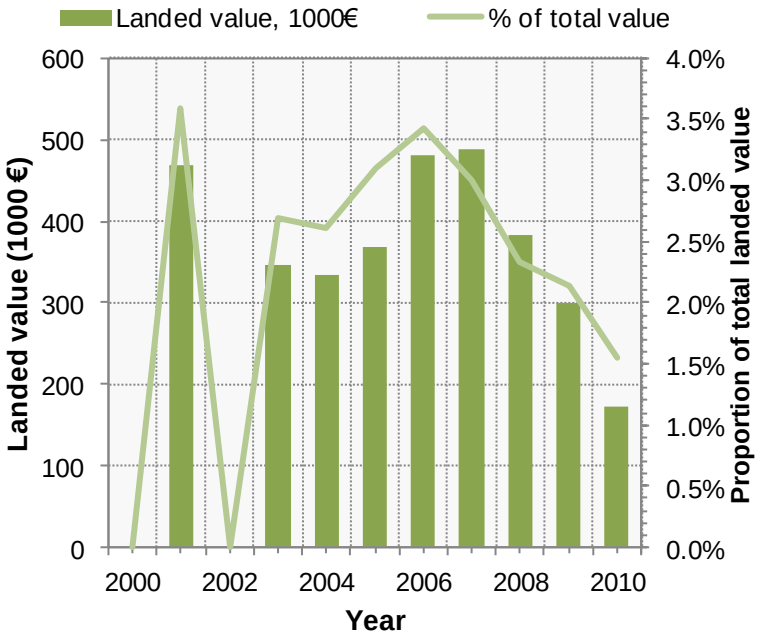

Figure 33. Landed value (1000€) of the bottom longline and handline fishing fleet in Madeira archipelago (data from DGRM). The proportion of total landed value is also shown.

Environmental Issues

Bycatch of sensitive species

No information is available to assess the bycatch of sensitive species in Madeira Islands bottom longline fleet.

Effects of fisheries on natural habitats

No information is available to assess the Effects of fisheries on natural habitats in Madeira Islands bottom longline fleet.

Influence of the environmental quality of the water on fisheries performance

The influence of the environmental quality of the water on fisheries performance is unknown. However, it is unlikely that environmental quality of the water is declining and affecting fish resources and fisheries performance.

Other fisheries

Commercial harvesting of coastal invertebrates

As in the Azores, consumption of costal invertebrates is part of the local cultural heritage and has an important social aspect. This species, mostly limpets *Patella aspera* and *P. candei*, are hand collected the intertidal zone while scuba diving both as recreational and professional activity. There are some minimum size, bag limit and temporal closure regulations in Madeira. Estimated landings of both species for the professional sector summed up to 97 tonnes in 2008 and a landed value of about 580 thousand Euros (Henriques, 2010). Limpet stock in Madeira Island experience high fishing mortality and exploitation rates (Henriques et al., 2012). Coastal crustaceans' fishery seems to be important in terms of value and fishing effort but annual landings are almost negligible. No information was found for this fishery in Madeira Island.

Deep water traps

From 2005 to 2008 a series of research cruises were carried out off the Canary and Madeira Islands to explore the fishery potential of the deep sea crab *Chaceon affinis* (Freitas et al., 2010). Bottom traps with lateral entrance or upper entrance baited with chub mackerel have been tested between 600 and 1100 m. Catch in Madeira waters was composed of 50% in weight of *C. affinis* and 50% by-catch, mostly of other crustacean species.

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