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Regional Secretariat for the Sea, Science and Technology

Regional Directorate of Fisheries

Supporting evidence on a high survivability exemption to the landing obligation of blackspot seabream (*Pagellus bogaraveo*) captured by bottom hook and line in Central North Atlantic Waters (ICES sub-area X)

May 2018



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GENERAL INTRODUCTION

Discards in fisheries is the part of the catch returned to the sea composed by dead or alive specimens (Catchpole *et al.*, 2013; FAO, 1996). Reasons for discarding include a complex set of decisions taken by fishers while sorting the catches (Eliassen *et al.*, 2014; Rochet and Trenkel, 2005) however, legal obligations (e.g. minimum landing sizes, exhausted species quota) or economic incentives (e.g. low or no market value) are often the preponderant drivers. Ethically, it is a waste of living resources and under an ecological point of view have a negative impact on the marine ecosystem provoking changes in the overall structure of trophic webs and habitats, which compromises the sustainability of the fisheries (Bellido *et al.*, 2011). At the end, discarding results in the loss of valuable scientific information for stock assessment purposes, as fishing mortality is not quantified (Diamond and Beukers-Stewart, 2011). Quantifying discards is therefore a necessary step for a more realistic and relevant management of fisheries, especially within an Ecosystem Based Management context (Bellido *et al.*, 2011; Hall *et al.*, 2000; Viana *et al.*, 2013).

European Union (EU) fisheries are responsible for quite high level of discarding (Feekings *et al.*, 2012) attributed to unselective fishing techniques, excess fishing effort and patchy distribution of species (Johnsen and Eliassen, 2011). To eliminate the “discard problem” the recent reformed Common Fisheries Policy (CFP) in article 15, formally implemented the obligation to land all catches (EU regulation 1380/2013). One of the main objectives of the policy is to end the practice of discarding of all species subject to European quotas and will come into force between 2015 and 2019 according to species and areas. This represents a fundamental shift in the management approach to EU fisheries, switching from landings monitoring to catches monitoring. This change in fisheries management strategy aims to improve fishing behaviour through improvements in selectivity. However, a number of exemptions can be requested by Member States, namely: i) prohibited species; ii) species for which high survivability can be scientifically demonstrated; iii) the *minimis* exemptions



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that allows up to 5% discards under certain conditions if it is evidenced that better selectivity is difficult to achieve.

Historically the discarding problem in the EU has been associated with medium to large-scale fleets in particular largely mixed species trawl fisheries. However, the EU landing obligation (LO) will implicitly include all small-scale fisheries that account around 7% of discards at the global scale (Zeller *et al.*, 2017). The appropriateness and feasibility of the LO in small-scale fisheries are unpredictable in the long-term, but available evidence suggests that in the short to medium-term a LO is likely to bring more negative social, economic and ecological impacts than benefits (Veiga *et al.*, 2016). Small-scale fisheries are predominant in the Azores, a Portuguese archipelago, located in the north Atlantic along the Mid-Atlantic Ridge, within 1360 km from Europe and 1925 km from America (Carvalho *et al.*, 2012). Given their remoteness, combined with their insularity, small size, difficult topography and climate, economic dependence on a few products, that restrain their economic and social development, the nine islands of the Azores archipelago belong to the outermost European regions. Fisheries, mostly small-scale and artisanal, are central to the local economy. As in other European small-scale fishery, the LO would likely entail severe socio-economic consequences for thousands of Azorean families, and compromise the efforts made so far in fisheries management, which has been developed in the Azores with encouraging results. In fact, the progress achieved in recent years to make the fishery sector more competitive, keeping the socioeconomic and resources sustainability, the Region is weaker to issues related to LO. Accordingly, the Region considers that the fishery sector needs special recognition and protection, not only because it is a remote archipelago with many rural communities, heavily dependent on the fishing sector for their economic wellbeing, but also because of the selective nature of the artisanal fishing techniques used that contribute towards the sustainability of marine resources and habitats. Fishing in the Region is monitored through different projects that cover all the fisheries. Moreover, as set in Article 349 of the Treaty on the Functioning of the European Union, whose legal status was reinforced by the decision of the EU Court of Justice, in its ruling of 15 December 2015 (Joined Cases C-132/2014 C-136/2014), the adoption of measures by the European Union,



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including in fisheries policy, should consider the structural, economic and social situations of the outermost regions such as the Azores. The vast majority of the boats will face severe constraints to adapt to the LO which will cause a great number of bankruptcies, and an increase in unemployment in the sector.

PART I. THE AZOREAN FISHERIES

The Azores is a Portuguese oceanic archipelago in the mid North-Atlantic Ocean, composed of nine islands. Maritime territory encompassing nearly a million square kilometers and for which marine resources are central to the local economy. With the absence of a continental shelf and surrounding great depths, fishing occurs around the island slopes and the seamounts present in the area (Silva and Pinho, 2007; Morato *et al.*, 2008). This represents less than 1% of the total area that can potentially be used up to a depth of 600 meters. The uniqueness of the Azorean waters, besides limiting the available areas for fishing activity, requires a very careful application of the precautionary principle in order to guarantee the biological conservation of the fishery resources. In fact, the Economic Exclusive Area of the Azores has a lot of water, great depth and little fish.

The main fisheries components in the Azores was described by Carvalho (unpublished data) and Morato (2012) and can be resumed as: i) the deep-water bottom longline and handline (hooks and lines) fisheries targeting mostly deep-water demersal fishes such as blackspot seabream (*Pagellus bogaraveo*), Atlantic wreckfish (*Polyprion americanus*), alfonsinos (*Beryx* spp.) and the blackbelly rosefish (*Helicolenus dactylopterus*); ii) the Azores pelagic longline, Portuguese mainland pelagic longline, and the foreign pelagic longline fisheries targeting swordfish (*Xiphias gladius*) and blue shark (*Prionace glauca*); iii) the pole and line tuna fishery (including the live-bait); iv) the small-size pelagic fisheries targeting mostly blue jack mackerel (*Trachurus picturatus*) and chub mackerel (*Scomber colias*); v) the drifting deep-water longline targeting black scabbardfish (*Aphanopus carbo*)



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(Machete *et al.*, 2011); vi) the commercial coastal invertebrates; vii) the recreational fishing; viii) and the squid (*Loligo forbesii*) fisheries.

The bottom hook and line fishery to target deep water and demersal species is the main fishery in the Azores in terms of landed value, number of boats and jobs (Carvalho *et al.*, 2011). It is a small-scale fishery operating from coastal areas to offshore seamounts, within ICES sub-area X, all year round. Total landings of the commercial bottom fisheries contributing in average for 40% of all landed weight in the Azores. Considering the landed value is by far the most valuable representing about 75% of all landed value in the Azores. The current active fleet that operates with hook and lines is composed by 463 vessels, which represent 80% of the regional fishing fleet (SRMCT, 2018). It comprises about 2,500 fishermen and for many it represents the only form of income in the family. Note also that many fishing communities are located in remote villages with few employment alternatives other than fishing.

The Azores fleet is dominated by small-scale vessels (Carvalho *et al.*, 2011) with lengths less than nine meters which, despite decreasing over time, still account for around 62% of the Azorean fishing fleet in 2018 (Figure 1). Oppositely, the large-scale or semi-industrial vessels (i.e. > 16 m long) account for around 5% of the whole fleet.

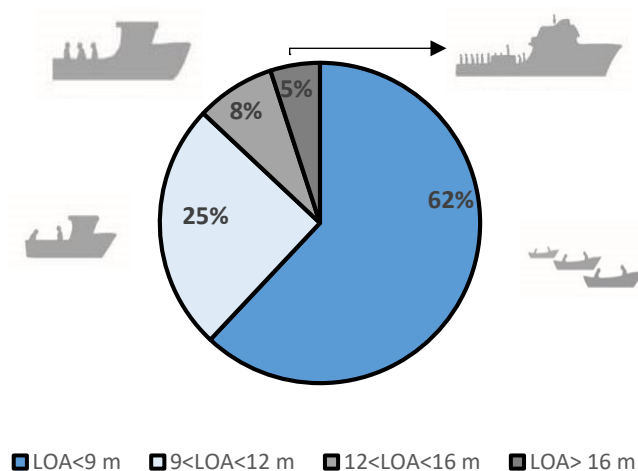


Figure 1. Fleet composition of the Autonomous Region of the Azores in 2018 by length classes.



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I.I Fisheries management strategies in Azores

Fisheries resources management strategies of the Azores are based on the CFP. Firstly, Total Allowable Catches (TACs) were implemented for several species such as blackspot seabream, alfonsinos and several deep-water sharks (EC Reg. 2285/2016). Apart from fish quotas the regional government has implemented several technical measures such as minimum landing sizes or weights, minimum mesh sizes, limitation of licenses for some specific gears (e.g. trammel nets), area and temporal closures and bans on the use of specific gear, such as the deep-sea trawling. The downsizing of the fleet has also been happening in the last years, which will allow the improvement on the protection of marine resources and the increase of the *per capita* income of fishermen.

The evolution of the number of fishing vessels in the Azores during the period 1991-2018 is shown in Figure 2. As a result of a set of incentives created in the Region to restructure the fishing sector and provide it with adequate technical conditions, the number of licensed vessels has declined significantly over the last 27 years (-43%). In 1992 the fishing fleet was composed by 959 vessels while in 2018, 548 vessels were licensed to fish in the Region with a total capacity of around 6800 GRT and engine power of 41500 kW (SRMCT, 2018).



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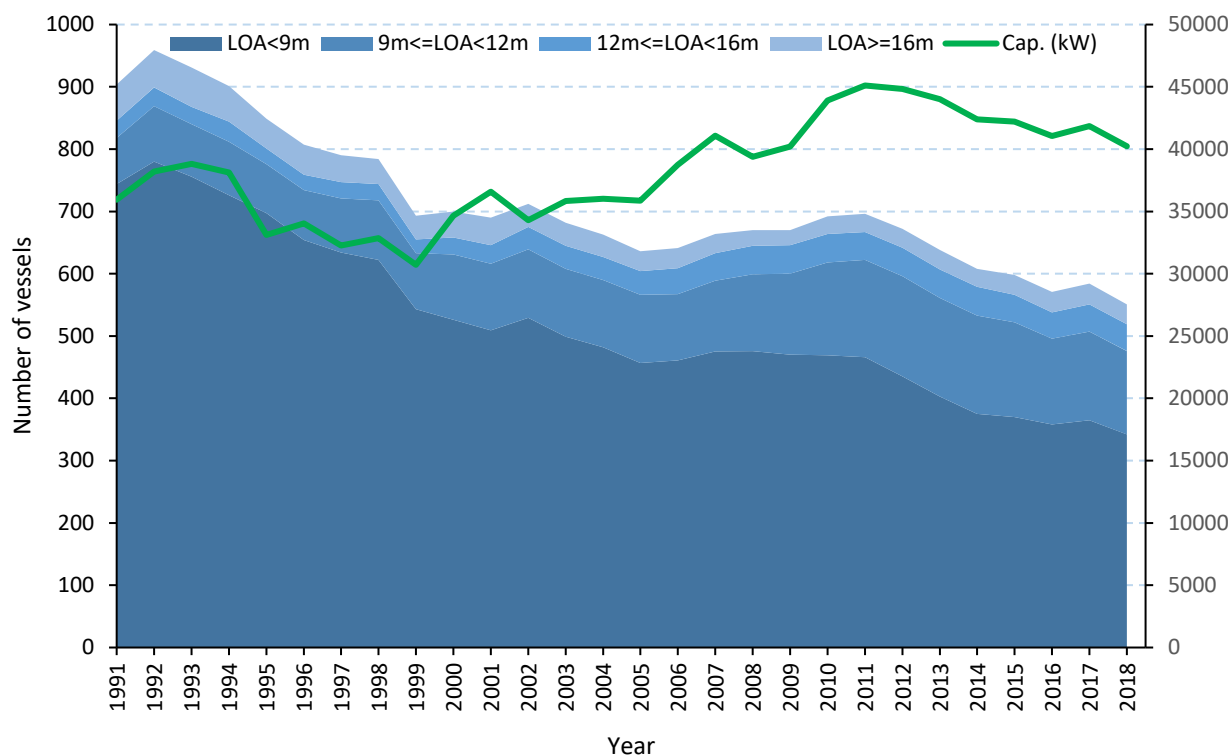


Figure 2. Evolution of the number of licensed fishing vessels and capacity in the Azores between 1991 and 2018.

The Region has also been reducing the number of licenses to fish with trammel nets and bottom longlines (Figure 3) favouring the handline fishing gear.

Additionally, following some experiment of deep-sea bottom trawling to target orange roughy (*Hoplostethus atlanticus*), that were undertaken in 2001 and 2002 (Melo and Menezes, 2002), the Regional Government of the Azores (RGA) required deep-sea bottom trawling to be forbidden inside the Azores EEZ in order to keep the sustainability of the fishing sector. This prohibition of deep-sea bottom trawling became an EC regulation in 2005 (EC 1568/2005) after the RGA's request.



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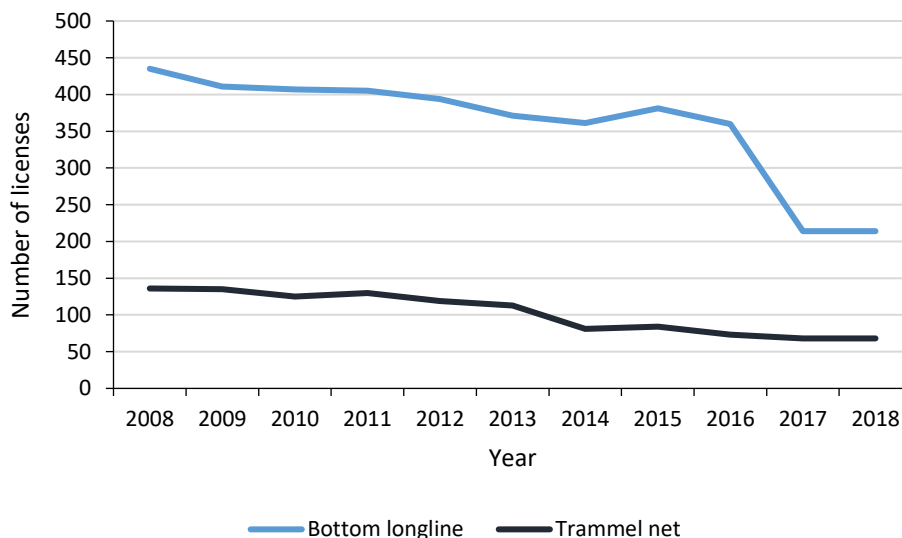


Figure 3. Evolution of the number of licensed fishing vessels to fish with bottom longline and trammel net in the Azores between 2008 and 2018.

The vast majority of the regional fleet (70% of the vessels), given their size, have their operating area limited to 6 nautical miles away from the coast and only 18% can operate at distances greater than 30 miles (Figure 4).

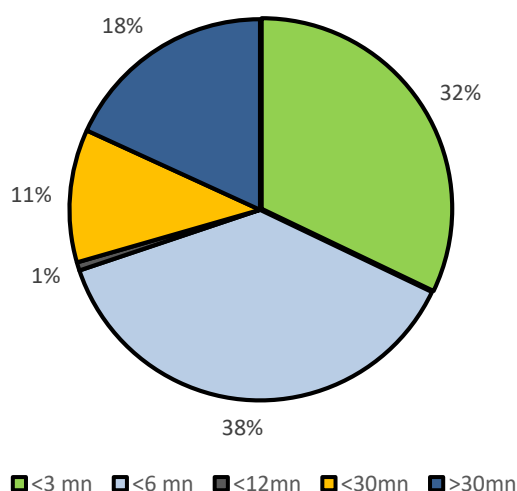


Figure 4. Operating area of the Azorean fishing fleet.



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I.I.I. Full list of management measures

A number of legislative initiatives has been put forward by the Regional Government since 2012. The mentioned initiatives aiming the diversity of the fishing techniques, limitations on access to fishing areas and the implementation of conservation management measures for a wide range of demersal species. We highlight the following initiatives:

- Ordinance 50/2012 of 27 April: establishes areas of more restrictive operations for coastal fishing boats. Boats until 14 meters' length are forbidden to fish within 1 nautical mile from shore and boats over 24 meters long may only fish beyond 30 nautical miles from shore;
- Ordinance 87/2014 of 29 December: establishes specific access rules and restrictions to fishing activities in the seamount areas of “Baixa do Ambrósio”, “Baixa da Maia”, “Baixa da Pedrinha” and the islet of “Ilhéu da Vila” in the island of Santa Maria, including a full ban of demersal fishing;
- Ordinance 88/2014 of 31 December: establishes specific rules for access and extends by three more years the ban of demersal fishing in the seamount “Banco do Condor”, to ensure the continuation of scientific projects to monitor the recovery of stocks;
- Ordinance 74/2015 of 15 June: eliminates the margin of tolerance of 15% below the minimum landing size in total blackspot seabream catches previously established in Ordinance 1/2010 of 18 January;
- Ordinance 74/2015 of 15 June sets a minimum landing size for blackspot seabream catches to 300 mm or 400 g, later in Ordinance 88/2016 of 12 August, the minimum size increased to 320 mm and 500 g, and actually by Ordinance 13/2017 of 31 January the minimum size is 330 mm.
- Ordinance 74/2015 of 15 June: clarifies that a closure of any fishery for having reached the fishing opportunities implies an immediate ban into recreational fishing;



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- Ordinance 74/2015, of June 15 - Defines the minimum sizes and closed periods. Amended and republished by Administrative Ordinance 13/2017, of January 31;
- Ordinance 74/2015 of 15 June: establishes an annual closure period for blackspot seabream between 15th January to 29th February. The established prohibition period coincides with the breeding season of the species in the Azores and has as its main objective the protection of spawning biomass;
- Commission Delegated Regulation (EU) 2015/98 of 18 November 2014 - Establishes derogations from the obligation to land under the International Convention for the Conservation of Atlantic Tunas and the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries. Atlantic - consolidated version 2017, as amended by Commission Delegated Regulation (EU) 2018/191 of 30 November;
- Ordinance 157/2015 of 4 December: allocates how the blackspot seabream quota is distributed between the islands, to ensure quota management per island;
- Ordinance 53/2016 of 21 June: lays down specific rules for fishing in the marine areas of “Monte da Guia”, in Faial island, and the “Ilhéus da Madalena” and “Baixa da Barca”, in Pico island, including a full ban of demersal fishing;
- Ordinance 54/2016 of 21 June: which applies specific rules for fishing in the areas of “Ribeira Quente”, in São Miguel island, including prohibiting of demersal fishing;
- Ordinance 55/2016 of 21 June: establishes specific rules for fishing in the “Baixo do Ferreiro”, in islets, “Ilhéu da Praia” and “Ilhéu da Baixa”, in Graciosa island, including a full ban of demersal fishing;
- Ordinance 12/2017, of January 30, changed the distribution of the region's share of Blackspot seabream to 2017 and 2018 by the different islands of the archipelago;
- Ordinance 189/2017, of 1 February, altered the distribution of the quota by the vessels of each island;
- Ordinance 1099/2017, of May 25, altered the distribution of quotas by the vessels of the islands of Faial, Terceira and São Miguel;



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- Ordinance 1276/2017, of June 16, altered the allocation of quotas by the vessels of the islands of São Jorge, Graciosa, Terceira and São Miguel;
- Ordinance 1562/2017, of 21 July, amended the allocation of quotas by vessels from the islands of Faial, Graciosa, Terceira, Santa Maria and São Miguel;
- Ordinance 1743/2017, of August 24, altered the distribution of quotas by the vessels of the islands of Corvo, Pico and São Miguel;
- Ordinance 1798/2017, of September 4, altered the distribution of quotas by the vessels of the islands of Corvo and Faial;
- Ordinance 71/2017, of 28 September, amended the allocation of the region's Blackspot seabream quota to 2017 for the different islands of the archipelago, taking into account the allocation of 34,462 tonnes, which added to the fishing possibility for 2017 applicable to Sub-area X of statistical classification of ICES - International Council for the Exploration of the Sea, for the Autonomous Region of the Azores;
- Ordinance 2250/2017, of 6 October, modified the distribution of the quota by the vessels of the different islands of the archipelago, taking into account the allocation of the 34,462 tonnes that increased to the fishing possibility for 2017 applicable to Sub-area X of the ICES statistical classification - International Council for the Exploration of the Sea, for the Autonomous Region of the Azores;
- Ordinance 79/2017, of 18 October - Approves the Regulation of the Fishing Method by Trap. Repeals Administrative Ordinance 30/2004, of April 22;
- Ordinance 2608/2017, of October 30, made available all the quotas defined by identification set not used or not exhausted, for 2017, to all vessels classified as local fishing and as inshore fishing, contained in the Ordinance 3022/2016 of December 30, amended by Order 189/2017 of February 1, republished by Declaration of Rectification 8/2017, of February 3, by Order 1099 / 2017, of May 25, Ordinance 1276/2017, of June 16, Ordinance 1562/2017, of July 21, Ordinance 1743/2017, of August 24, Ordinance 1798/2017, of September 4, and Order 2250/2017, of October 6;



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- Ordinance 90/2017, of November 30, changed the maximum volume of catches of each vessel, classified as coastal or local fishing, to 3% of the fishing possibility for the year 2017;
- Order 2897/2017, of December 4, made available all the quotas defined by set of identification not used or not exhausted, for 2017, to all vessels classified as local fishing and as constant coastal fishing. 3022/2016, of December 30, amended by Order 189/2017, of February 1, republished by Declaration of Rectification 8/2017, of February 3, by Order 1099/2017, dated May 25, Order 1276/2017, of June 16, Order 1562/2017, of July 21, Order 1743/2017, of August 24, Order 1978 / 2017, of September 4, and Order 2250/2017, of October 6, listed in the annex to this order, which forms an integral part of it. maintaining the maximum limit of 3% of total catch per vessel, in accordance with the provisions of paragraph d) of paragraph 1 of article 7 of Administrative Order 119/2016, of December 27, with the changes introduced by Ordinance 12/2017, of January 30, by Ordinance 71/2017, of September 28, and by Ordinance 90/2017, of November 30;
- Ordinance 94/2017, of December 28 - Approves the regulation of specific access for the exercise of fishing and access and permanence of vessels at the Banco Condor;
- Regulation (EU) 2017/2107 of the European Parliament and of the Council of 15 November - Establishes management, conservation and control measures applicable in the Convention Area of the International Commission for the Conservation of Atlantic Tunas (ICCAT);
- Commission Implementing Regulation (EU) 2017/2178, of 22 November 2017, amending Regulation (EU) 468/2010 establishing the list of EU vessels engaged in illegal, undeclared and unregulated fishing;
- Ordinance 3/2018, of January 16 - Fifth amendment and republishing of Administrative Ordinance 66/2014, of October 8, approving the conditions for fishing with Purse seine fishing gear and “Arte de Levantar”, for fishing vessels registered on São Miguel and Terceira islands;



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- Ordinance 4/2018, of January 22 - Regulation of coastal commercial fishery with lines, in the Autonomous Region of the Azores;
- Ordinance 32/2018, of March 29 - Extension of the Fishing Licenses for the year 2018;

I.II. Landings composition

During the period between 1994 and 2017, the average annual landings made in archipelago's fish auctions represented 11,994 tonnes corresponding to approximately 28.4 million euros. The fish traded in the auctions present a decreasing trend since the 2010 as a result of a significant reduction in tuna catches in the Azorean Seas (Figure 5). However, it should be noted that fish traded in the Region's auctions during 2017 amounted to about 29.5 M €, which represent a significant increase when compared to the value recorded in 2016 (SRMCT, 2018).

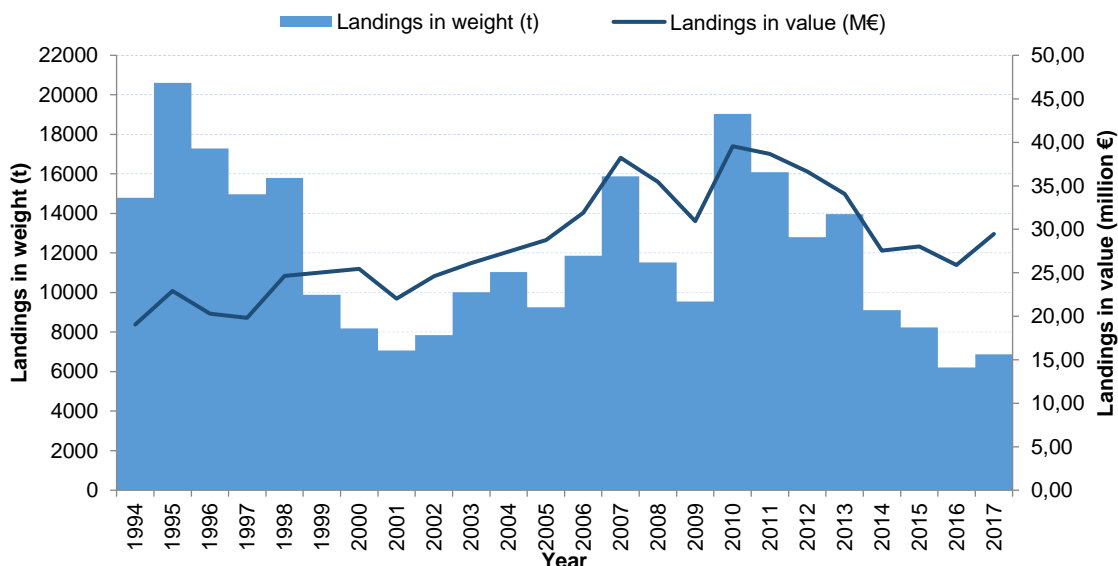


Figure 5. Evolution of landings by weight (tonnes) and value (million euros) during the period between 1994 and 2017 (Source: Statistical Regional System and Regional Auction).



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The analysis of catch composition per species group revealed that during the period between 1994 and 2017, landings by weight were dominated by pelagic species, which represented an average of 63% of the total landings (Figure 6). Considering the landings by value, it is possible to verify that the demersal species represent about 61% of the total value traded in the region auctions (Figure 7).

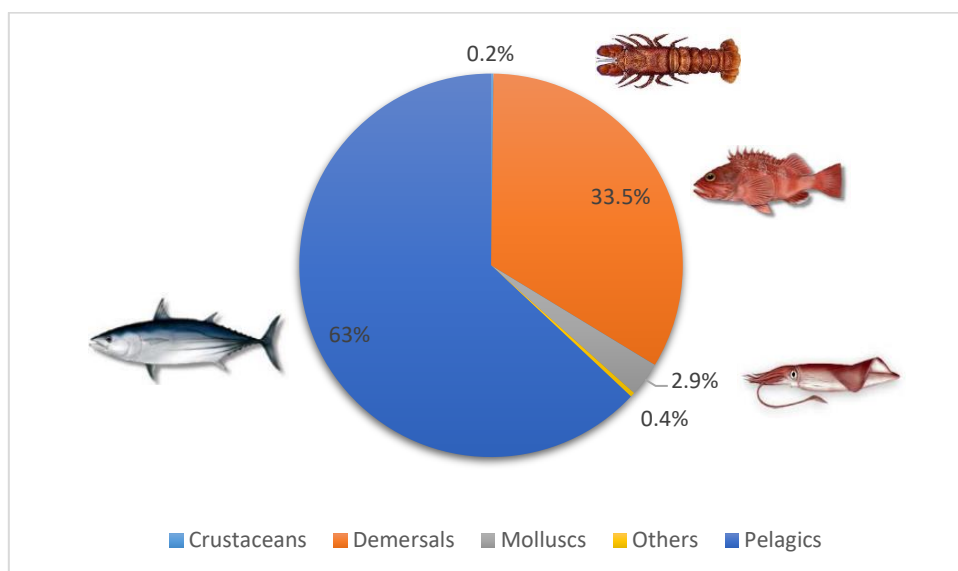


Figure 6. Relative composition of landings by weight during the period between 1994 and 2017 (Source: Statistical Regional System and Regional Auction).



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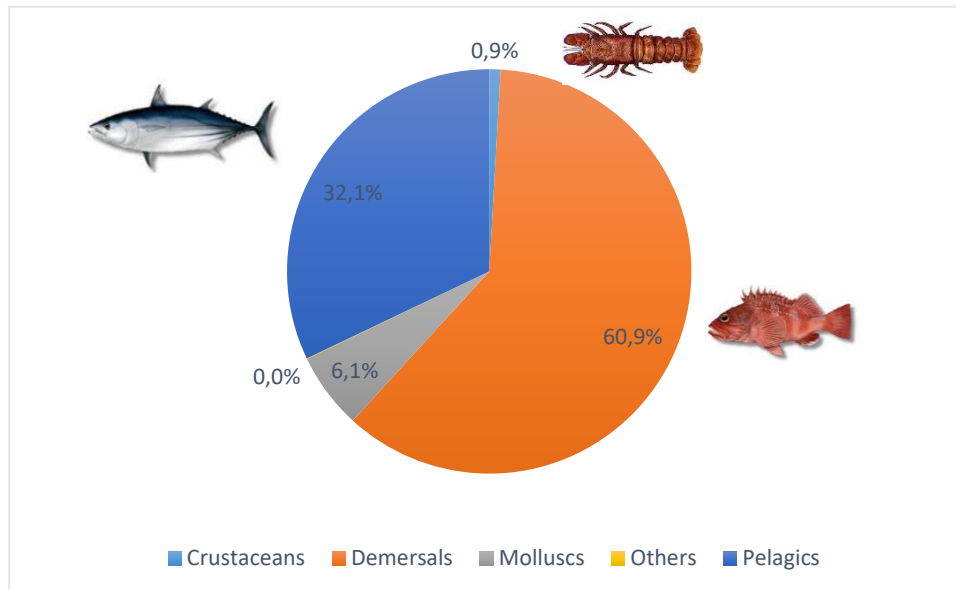


Figure 7. Relative composition of landings by value during the period between 1994 and 2017 (Source: Statistical Regional System and Regional Auction).

I.II.I Landings of demersal species

The analysis of demersal species landings between 1994 and 2017 revealed two distinct periods. The first was between 1994 and 2000 showing an annual average catch of 5,200 tonnes. The second, matching with the Ordinance nº7/2000, which banned the use of longlines at less than 3 nautical miles from the coast, with annual average catches of 3,525 tonnes. In terms of value, landings showed an increase trend up to 2007, reaching a maximum of 23.6 million euros, a decreasing trend between 2008 and 2013 and again an increasing trend in the last year of the period under analysis (Figure 8). It should be noted that the average price per kilo of demersal species has increased by 70% in recent years, from 4.01 €/kg in 2014 to 6.7 €/kg in 2017.



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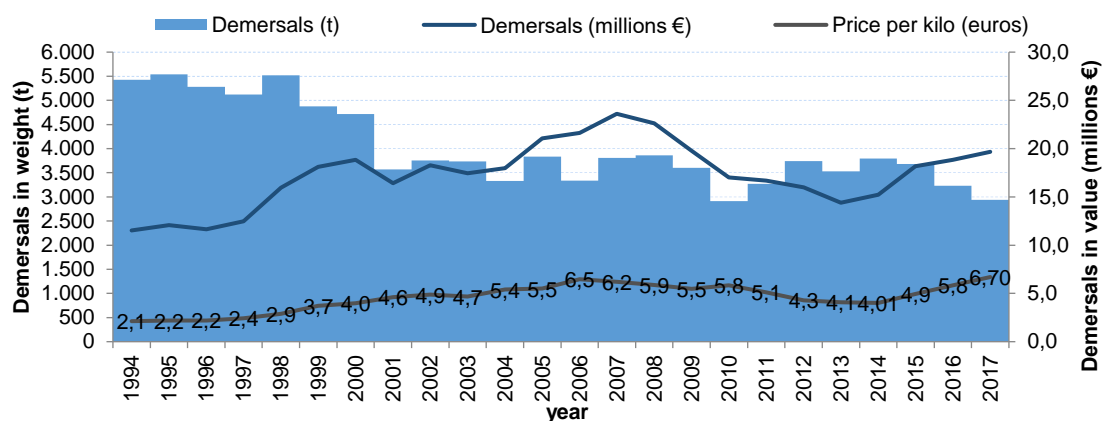


Figure 8. Evolution of demersal species landings by weight (tonnes), value (million euro) and average price per kilo between 1994 and 2017 (Source: Statistical Regional System and Regional Auction).

The catches of demersal species in the Region include about 70 species, and in the period 2007-2017, 10 species represented about 79% of the total landings. The most important species during this period were the Blackspot seabream (*Pagellus bogaraveo*) accounting an annual landing of 654 tonnes, the European conger (*Conger conger*) with 407 tonnes, Forkbeard (*Phycis phycis*) with 235 tonnes, the Blackbelly rosefish (*Helicolenus dactylopterus*) with 231 tonnes, the Atlantic Wreckfish (*Polyprion americanus*) with 210 tonnes, the Silver scabbardfish (*Lepidopus caudatus*) with 210 tonnes, the Parrotfish (*Sparisoma cretense*) with 190 tonnes, the Alfonsinos (*Beryx* sp.) with 182 tonnes, the Thornback Skate (*Raja clavata*) with 97 tonnes and the Black scabbardfish (*Aphanopus carbo*) with 90 tonnes.

I.II.II. Discards composition

As part of the DiscardLess project, the discards of all fisheries occurring in the Azores EEZ (ICES sub-area X), including the deep-water bottom longline and handline fishery, were



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estimated by species for the period 1950-2014. This work, completed the catch reconstruction work performed and published by Pham *et al.* (2013) and was submitted for publication by Fauconnet *et al.* (unpublished data).

Since 1950 to present, an average 784 t (95% CI, 588 - 1008 t) were discarded per year by Azorean fisheries, i.e. 5.0% of their total catch. Discarding has mostly increased since the 1950s until the turn of the century, from 240 t/year in the 1950s-60s to 450 t/year in the 70s-80s and 2080 t/year in the 90s. In the last 15 years, total discards dropped and broadly stabilized at 1070 t/year (Figure 9) (Fauconnet *et al.*, unpublished data).

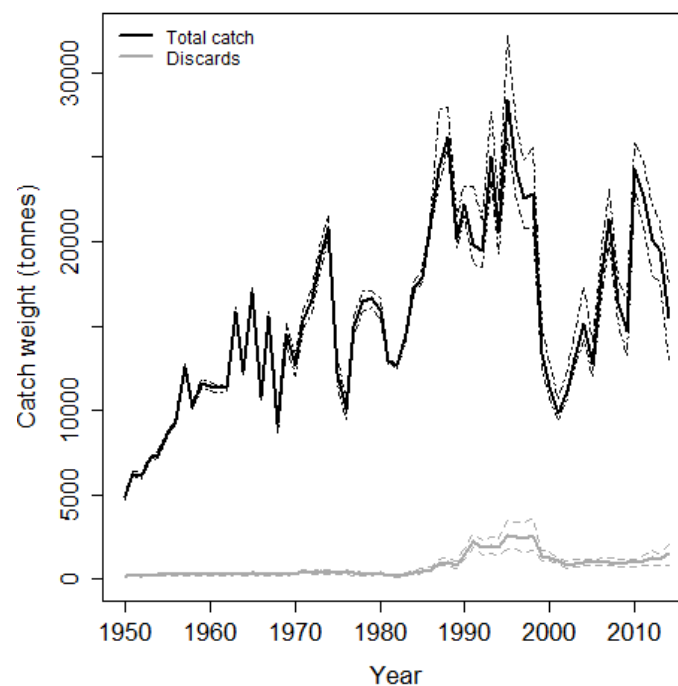


Figure 9. Time series of total catch (black line) and total discard (grey line) amounts of Azores fisheries. Dashed lines display 95% confidence intervals.

Over the recent 2000-2014 period, the bottom fishery in the Azores contributed the most to discards in weight (avg. 447 t/year, 10.3% of total catch), followed by the artisanal purse-seine fishery for small pelagic fishes (270 t/year, 13.0%), and the regional fleet of pelagic



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longliners (246 t/year, 43.6%). All other fisheries were estimated to discard less than 30 t/year.

I.II.II.I. Discards of the bottom longline and handline fishery

Data sources

An observer programme onboard commercial bottom longline and handline vessels has been implemented from 2004 to 2012 and 2016, as part of the PNRD (Plano Nacional de Recolha de Dados, i.e. Data Collection Framework). This information was completed with an observer programme conducted from 2017 to 2018, in collaboration between the projects DiscardLess, MERCES and Sponges. Between 2004 and 2018, a total of 538 fishing trips, 1900 days at sea and 1807 fishing operations were sampled by observers onboard commercial bottom longline and handline fishing vessels.

As part of the PNRD observer programme, vessels from the three main islands in terms of landed volume (São Miguel, Terceira and Faial), were randomly chosen for sampling, attempting to attain a full coverage of all vessel length classes of the fleet. Sampling coverage ranged between 0.9 and 3.1% of landings for the period 2004-2011.

All sets of a trip were usually sampled by the observer, and for each fishing operation data were recorded for:

- (i) Type, and technical characteristics of the gear and fishing operations;
- (ii) Species composition of the total catch (retained and discarded), and landings (collected at the fish auction following the trip) in number and biomass;
- (iii) Lengths - measured to the nearest centimeter below from total or fork length (cm) or opercular length if damaged for fish species, carapace length for crustaceans and mantle length for cephalopods - of retained (subsample), discards (census) and landings (subsample);
- (iv) Sex for elasmobranchs;
- (v) Fate of the retained fraction of the catch that, if not landed, can either be used as bait, as food for the crew, or offered as “gifts” while landing. The observers did not



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interfere with fishing operations or the decision to whether or not discard a certain species.

- (vi) Reason for discarding as reported by fishers for each individual. Four reasons for discarding were recorded: undersized, no commercial value, damaged and other. “Undersized” includes fish discarded due to minimum landing size motives and also fish with commercial value that were discarded because they were too small to attain any value in the market. “No commercial value” includes species with an absence of market and also species for which the quota was reached. “Damaged” fish resulted either from predation while hooked in the gear or from on board mishandling. “Other” was used when reason for discarding could not be identified.

Discard estimates

Over the 2000-2014, discards of the bottom fishery were estimated to represent 10.3% of the total catch of the fishery, representing 447 t discarded per year in average. The Azorean bottom fishery (longlining and handlining combined), as in many other small-scale fisheries worldwide produce a very low by-catch and discard (Gillet, 2011) which is also a result of a combination of particular technical-cultural and socioeconomic characteristics, namely the selectivity of the gear and the traditional use as bait or own consumption.

A high number of species (145 species) were caught in the bottom longline and handline fisheries. Although most of these have minor commercial value, the species caught in highest proportions bear high commercial value and feed a well-developed local market (Table I). The two most valuable species, blackspot seabream and wreckfish, were very little discarded (2.2% and 0.3%, respectively) whereas splendid alfonsino, blackbelly rosefish and European conger, all commercial species subject to MLS, were discarded in slightly higher proportions (around 10% of their catch). The major part of discards is composed by five commercially important fish species (*P. bogaraveo*, *H. dactylopterus*, *B. splendens*, *C. conger*, *L. caudatus*) and one deep-sea shark (*E. spinax*).



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Table I. Species contributing to over 1% of the total catch of the bottom longline and handline fishery (highlighting * = quota, ° = TAC 0, ^ = MLS), with contribution to the total catch weight of the fishery, annual discard weight estimate and 95% confidence intervals (CI) in tonnes, and discarded weight fraction, for the 2000-2014 period.

Species	Common name	% of total catch weight	Discard weight (t) per year	CI Discard weight (t) per year	Discarded fraction (%)
[^] <i>Pagellus bogaraveo</i>	Blackspot seabream	22.64	21.27	[13.83 - 28.69]	2.17
[^] <i>Conger conger</i>	European conger	12.00	68.94	[50.92 - 87.98]	13.25
<i>Polyprion americanus</i>	Wreckfish	7.16	0.81	[0.17 - 1.45]	0.26
<i>Lepidopus caudatus</i>	Silver scabbardfish	7.12	104.49	[34.93 - 179.99]	33.82
[^] <i>Helicolenus dactylopterus</i>	Blackbelly rosefish	6.92	32.65	[19.71 - 45.45]	10.88
<i>Phycis phycis</i>	Forkbeard	5.78	13.68	[7.72 - 19.8]	5.45
[^] <i>Beryx splendens</i>	Splendid alfonsino	4.81	22.01	[16.86 - 26.83]	10.55
<i>Raja clavata</i>	Thornback ray	2.53	24.59	[7.76 - 41.83]	22.44
[^] <i>Pagrus pagrus</i>	Common seabream	2.10	1.12	[0.65 - 1.6]	1.23



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<i>Centrophorus squamosus</i>	Leafscale gulper shark	1.92	17.84	[8.76 - 47.68]	21.43
<i>Mora moro</i>	Common mora	1.72	3.53	[0.73 - 6.32]	4.72
<i>Serranus atricauda</i>	Blacktail comber	1.67	0.12	[0.04 - 0.19]	0.17
<i>Galeorhinus galeus</i>	Tope shark	1.50	4.27	[0.01 - 8.53]	6.58
<i>Pontinus kuhlii</i>	Offshore rockfish	1.41	2.09	[1.07 - 3.1]	3.42
<i>Muraena helena</i>	Mediterranean moray	1.21	7.63	[2.66 - 12.65]	14.57
<i>*Aphanopus carbo</i>	Black scabbardfish	1.04	4.32	[2.17 - 11.37]	9.56
Others	Others	18.47	117.95	[63.48 - 177.43]	14.73

I.II.III. Reasons for discarding and impacts of the LO on Regional fisheries

The reasons for discarding in this fishery were analysed, based on observer data, by Canha (2013) and Fauconnet *et al.* (unpublished data). At the fishery level, the Minimum Landing Size (MLS) was identified as the main reason for discarding while the low market value was the second cause for discarding. The capture of damaged individuals is also pointed as another important reason. Yet, it is important to note that the LO does not apply to damaged individuals, but that this type of discard is included within the displayed discard estimates. In few cases, the quota can also constitute an important reason for discarding. In fact, the implementation of the TAC system coincides with the recent increase in discarding,



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especially due to the quota for splendid alfonsino, which was reached increasingly earlier in the last decade (Figure 10). In addition, the wide inter-annual fluctuations in abundance of silver scabbardfish occasionally lead to large catch amounts of this species, which is discarded in large proportions due to low market value or small sizes (Figure 11).

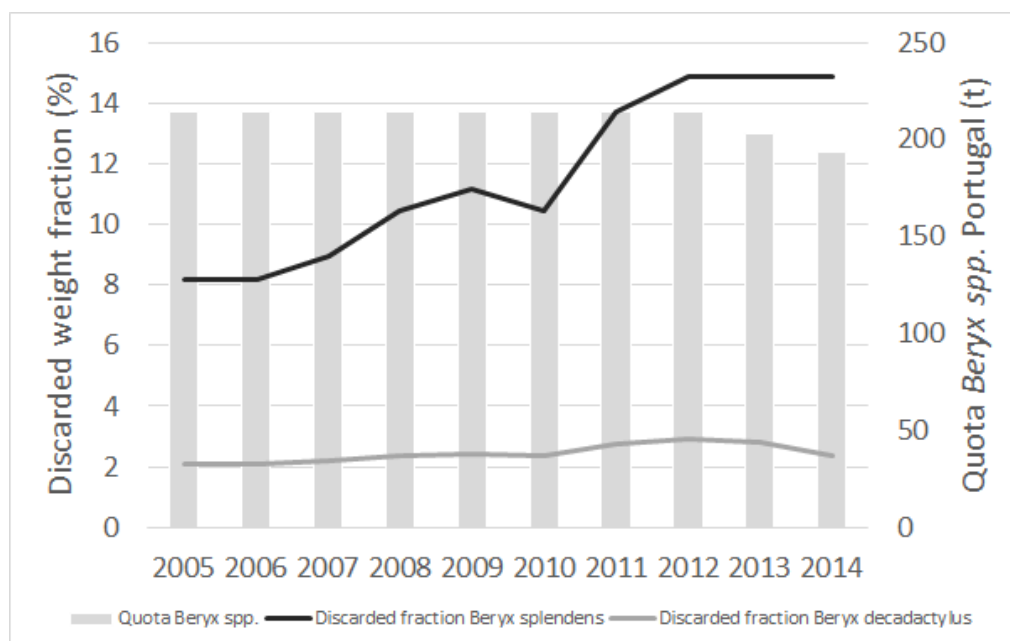


Figure 10. Discarded fraction of alfonsinos *Beryx splendens* (black line) and *B. decadactylus* (grey line) versus the annual *Beryx* spp. quota (grey bars) allocated to Portugal for ICES sub-area Xa over the 2005-2014 period.



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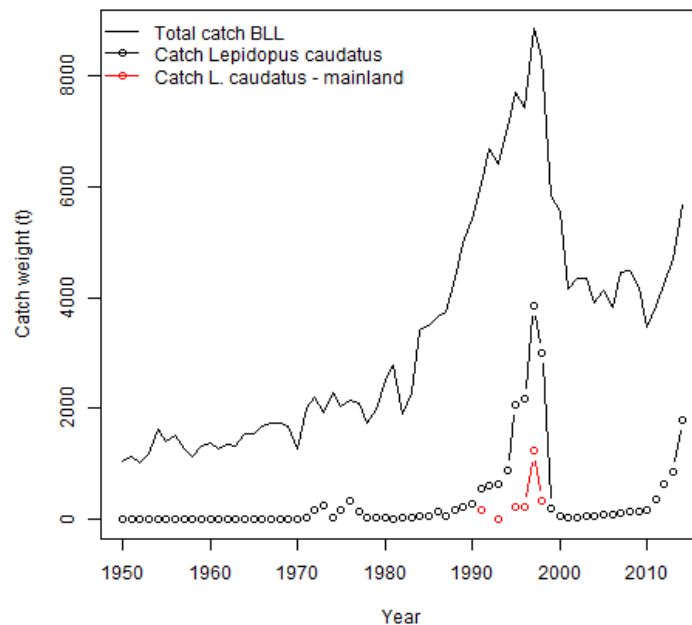


Figure 11. Total catch of the bottom longline and handline fisheries combined (black full line), including total catch of silver scabbardfish *Lepidopus caudatus* (black dotted line) and only by the mainland Portugal fleet (red dotted line) over the 1950-2014 period.

Overall, regulations under the previous CFP, were the main reason for discarding in this fishery, as the main target species are subject to quota and/or MLS. The implementation of the TAC system has been one of the main driver for the discard increase in this multi-specific fishery, with for example the continuation of alfonsino discards after their landings stopped upon reaching the quota.

Given this scenario, it follows that one can expect considerable impacts of the recent reform in the European fisheries management (European Commission, 2013) in Azorean fisheries. While regulatory reasons (mainly MLS and quota) were compelling fishers to discard under the previous CFP, the LO will now compel fishers to bring back on land all catch of quota species, drastically changing those constraints. Catch quotas will replace landing quota, and all individuals including those under the Minimum Conservation



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Reference Sizes (replacing MLS) have to be landed. The LO should therefore result in decreasing discards, as observed globally (Zeller *et al.*, 2017). However, the efficiency of such measure strongly relies on the level of compliance and enforcement (Borges *et al.*, 2016). The LO may not result in a dramatic reduction in unmarketable catches if better selectivity is not incentivised (Condie *et al.*, 2013), if a better selectivity can be achieved. Even if the fishing selectivity is high and discards are low in Azorean fisheries, the LO could negatively affect them. The potential “choke” species (i.e. species for which the quota would be reached first forcing fishers to stop fishing) are alfonsinos and blackspot seabream for the deep-water bottom longline and handline fishery, the main fishery in the Region in terms of landed value, number of fishing vessels and number of fishers. Potential socio-economic impacts of the LO could therefore be highly detrimental in Azorean commercial fisheries, as argued for other small-scale fisheries for which the LO seems inappropriate (Veiga *et al.*, 2016; Villasante *et al.*, 2016).

PART II. STATE OF SCIENTIFIC KNOWLEDGE ON THE POTENTIAL FOR SURVIVAL OF RELEASED BLACKSPOT SEABREAM (*Pagellus bogaraveo*)

II.I. Introduction

In the Azores, fishing for blackspot seabream is carried out in a traditional "hook and line" fishing framework with predominantly multi-species characteristics aimed at a group of demersal and deep water species. The fleet fundamentally operates in Azores (ICES sub-area X), within the Portuguese Exclusive Economic Zone.

The hook and line segment of the Azorean fleet is mostly made up of small boats that are less than 10 meters long (76%) which develop their activity with hand lines in coastal areas and in the seamounts close to the islands of the archipelago. The larger boats, with an average of 10 fishermen, operate mainly with bottom longlines in the areas further away from the coast.



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During 2017, 463 vessels landed blackspot seabream. Among those vessels for 182 the blackspot seabream represented more than 25% of the annual income and for 91 this species represented more than 50% of the annual income (Table II).

Table II – Catch fraction of blackspot seabream in the total Azorean catches, per island (in % of total value; Source: Regional Auction).

	S Maria	S Miguel	Terceira	Graciosa	S Jorge	Pico	Faial	Flores	Corvo	Total Azores
2012	1.07%	8.69%	29.15%	59.66%	5.98%	6.18%	16.00%	34.99%	51.19%	13.73%
2013	0.87%	9.85%	32.99%	77.36%	9.44%	2.63%	28.51%	38.30%	70.99%	15.80%
2014	6.77%	8.97%	39.66%	83.74%	8.32%	9.05%	27.27%	55.37%	40.31%	20.34%
2015	10.59%	13.19%	36.16%	82.26%	13.18%	10.08%	30.43%	41.25%	20.48%	22.94%
2016	11.61%	16.85%	34.98%	61.06%	11.71%	9.24%	38.36%	29.80%	40.64%	23.75%

II.II. Methods

II.II.I At-vessel mortality / Onboard observer data

From February 2017 to January 2018, an onboard observer program was carried out as part of the DiscardLess project, in collaboration with the MERCES and Sponges projects, with the objective of monitoring catches from the commercial deep-water bottom longline and handline. The sampling took place all year long off Faial and São Miguel islands (Azores, Portugal).

Within this program, two main objectives were pursued: i) collect information on the fishing effort and catches at the fishing operation/set level, by identifying species caught, landed and discarded, in number of individuals, measure the discarded individuals and register the reason for discarding, and ii) evaluate at-vessel mortality and condition of fishes caught by the commercial bottom longline and handline fishery.



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Observers were therefore asked to alternate two types of discard sampling: length sampling, and “survivability” sampling, with one survivability sampling and four length sampling every five fishing operations/events.

In the survivability sampling, the observers were asked not to interfere in the fishing operation and handling of the catch, but just to observe and register all discarded individuals. The information collected included: species identification, length estimation (to 1 cm for individuals smaller than 30 cm, to 5 cm for larger individuals), hooking position, condition of the fish, handling by the crew, vitality state of the fish at release/when discarded, and reason for discarding.

The vitality state of the discarded fishes was evaluated at the moment of the release. The vitality was assessed according to the status described in Table III.

Table III. Description of the characteristics of each vitality status.

Vitality status	Description
Vigorous	Strength in its body, moves without stimulus and is able to do a ‘tail-flip’, strong swim towards the bottom
Stunned	Moves but with difficulties in sinking / going down, disorientated
Moribund	Only the gills or opercles move, or has spasms, hardly moves or only if stimulated, but does not swim
Dead	Doesn’t move at all and shows no reaction to stimulus

To better evaluate the condition of the fishes and their chances of post-release survival, the information on the vitality at release was completed by information on the hooking position, evaluation of the fish condition and handling by the crew onboard. The hooking position was registered as in the mouth, the stomach (gutted), the eye or the body. The



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evaluation of the fish condition recorded whether the fish presented lesions in the stomach (evagination, stomach protruding from the mouth), the eye (blind or exophthalmia), the body, any bleeding (for example of the gills), or none. The handling by the crew included information on whether the fisher cut the line (i.e. leaving the fish on the hook), removed the hook by hand, left the fish in a box (before deciding to discard or keep it), hit the fish in the floor or on the vessel edge, or removed air from an inflated fish (vessel bladder) before release. No special handling was considered when fishers used the dehooking tool.

II.II.II. Post-capture survival / Captivity - in tank data

Post-capture survival studies are often conducted in the laboratory (aquaria or tanks) where the survival is monitored in specific time intervals for 3 to 8 days (e.g. Depestele *et al.*, 2014; Bell and Lyle, 2016; Tsagarakis *et al.*, in press). However, conducting post-capture survival studies with deep-water fish is very challenging due to difficulties in maintaining water pressure, temperature and light conditions similar to those in the natural environment. With the exception of small fish hyperbaric chambers developed at the Hubbs-SeaWorld Research Institute (Smiley and Drawbridge, 2007) and the Monterey Bay Aquarium (Welsh, 2012), no large scale facilities exist to conduct post-capture survival studies of fish caught at depth that would mimic the local environmental conditions and that could separate the fishing effect from the others environmental effects. Somewhat surprisingly, many fish caught at depth and showing severe barotrauma can fully recover if quickly returned back to depth (Jarvis and Lowe, 2008; Hannah and Matteson, 2007; Hochhalter and Reed, 2011).

Flying Sharks (<http://flyingsharks.eu>) is a local SME, established in 2008 in Horta (Faial island, Azores), dedicated to promoting a sustainable use of the Oceans, through providing live marine animals to International Institutions focusing on Education and Research on the marine environment. Flying Sharks has been flying live marine animals to public aquaria all over the World (from Japan to the USA, Turkey to Dubai, Singapore to Saudi Arabia, all European countries to Russia, and many other locations) and are now responsible for the Porto Pim Aquarium in Faial. Every year the company submits an annual report to the



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Regional Government of the Azores to account for their activities, namely numbers of animals caught, including by-caught, but also number of mortalities, and transported animals. Flying Sharks has kept records of catch, survival and mortality levels in a consistent way for over 5 years.

II.III. Results

II.III.I. At-vessel mortality / Onboard observer data

From February 2017 to January 2018, 138 fishing operations of bottom longlines as part of 34 trips, and 2910 fishing events of handlines as part of 43 trips were sampled by onboard observers. Survivability was assessed on 25% and 45% of the fishing operations respectively (Table IV).

Table IV. Description of the sampling effort by gear for all fishing operations (FOs) and specifically those focusing on the survivability.

	Bottom longlines		Handlines	
	All FOs	Including survivability FOs	All FOs	Including survivability FOs
No. vessels	9	7	9	8
No. trips	34	24	43	30
No. days at sea	201	34	111	52
No. FOs	138	34	2910	1318

The fishing operations sampled were widely distributed within the archipelago, mostly focused on the coastal areas, island slopes and the shallowest seamounts (Figure 12). The survivability sampling was consistently widely distributed.



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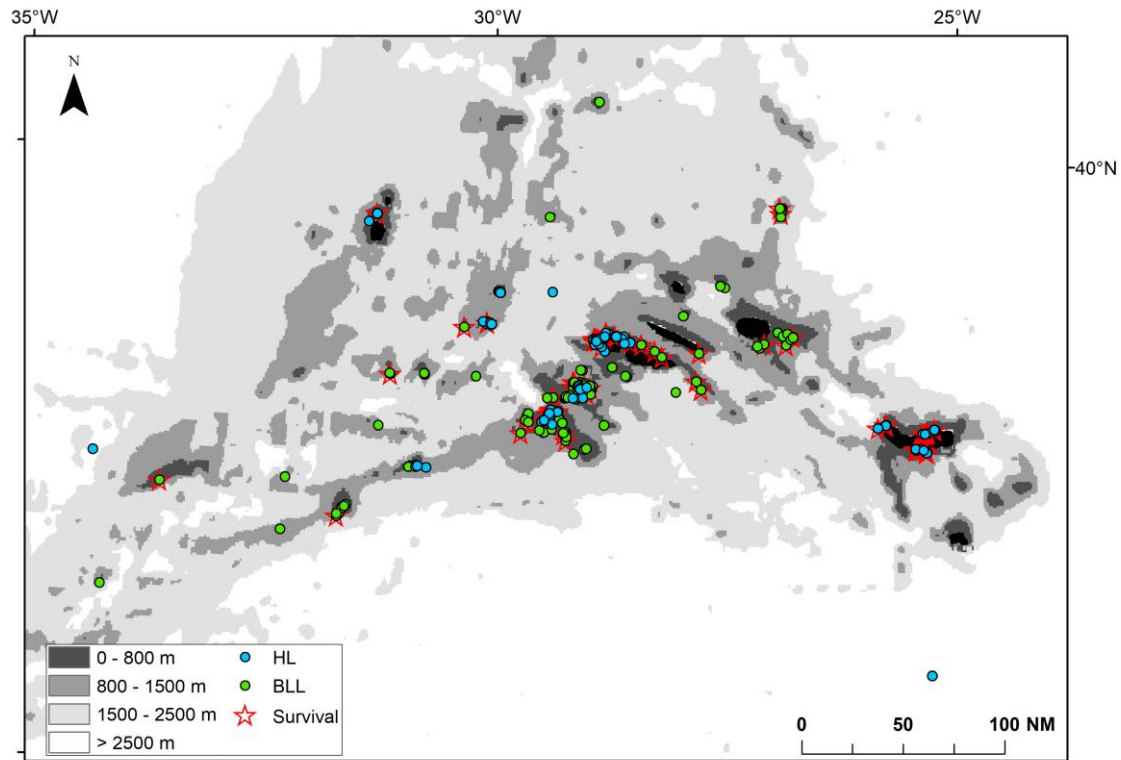


Figure 12. Map of sampled fishing operations in 2017-2018 for handlines (HL) and bottom longlines (BLL), including survivability observer sampling. Grey coloured areas display bottom depth in meters.

Both bottom longlines and handlines are performing all year long, but as handline vessels are generally small open-deck wooden boats, their activity is higher in summer when the conditions are more favourable. Sampling of the activity and catch of both gear types was performed all year long, as such as survivability sampling (Figure 13).



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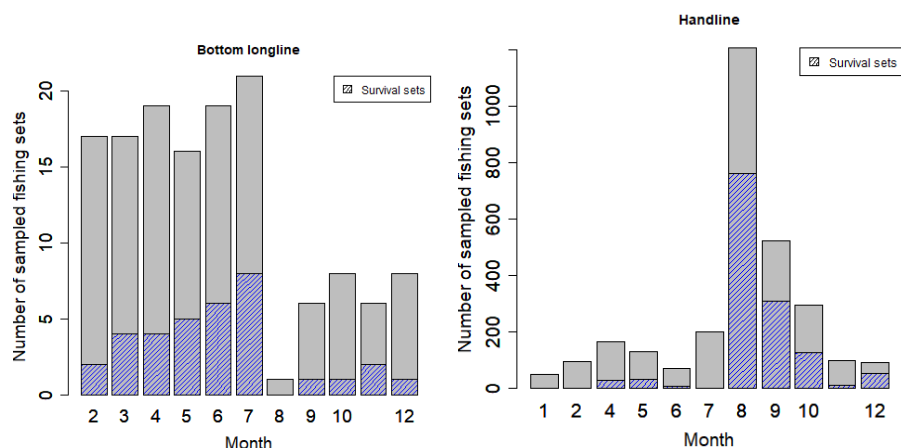


Figure 13. Distribution of sampled fishing operations by month.

The characteristics of the FOs with survivability sampling were similar as those of all sampled FOs within each gear, both in term of mean fishing depth (Figure 14) and number of hooks deployed by fishing operation (Figure 15).

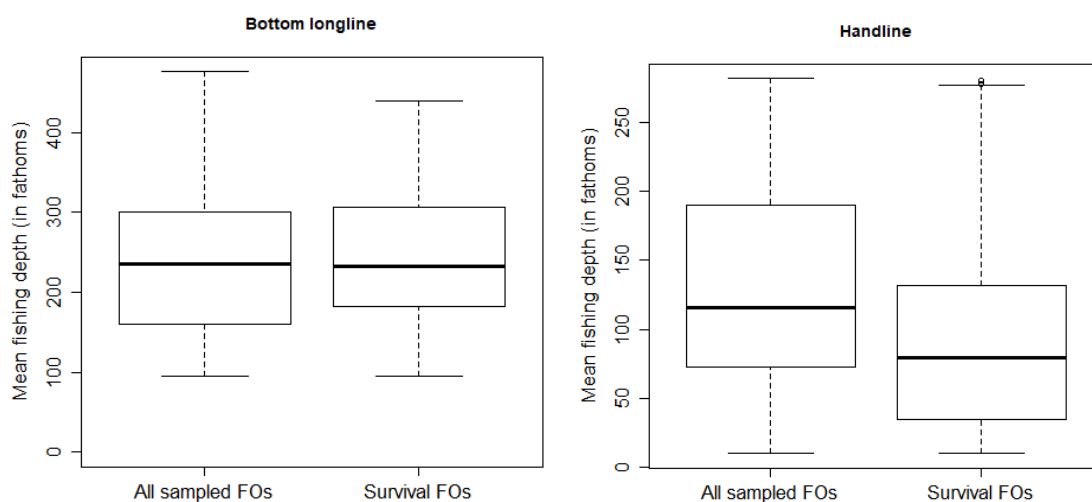


Figure 14. Mean fishing depth (in fathoms) of sampled fishing operations (FOs) including survival FOs, by gear.



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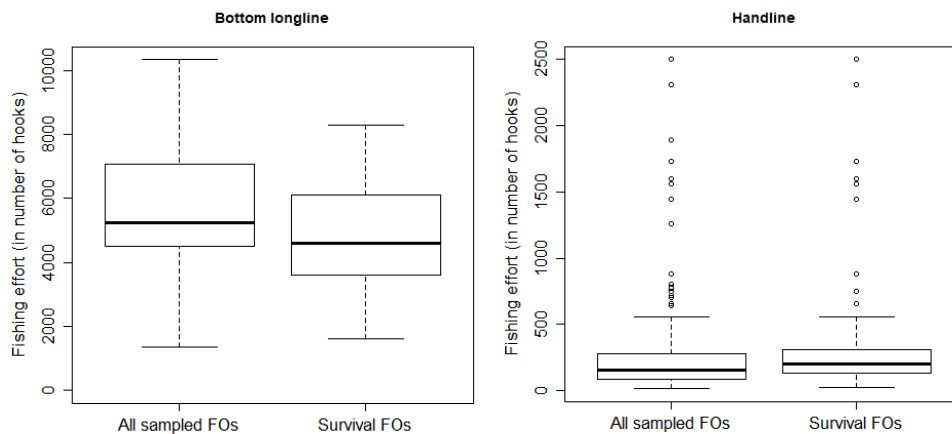


Figure 15. Fishing effort (in number of hooks) deployed by fishing operation (FO) for all sampled fishing operations, and especially for survival FOs, by gear.

The survivability sampling appears to adequately cover the fishing activity, characteristics and conditions of the bottom longline and handline fishery. Within the survivability sampling, a total of 213 blackspot seabream specimens were sampled from handline and 413 from deep-water bottom longline. Figure 16 shows the vitality state of the sampled individuals caught with handline and deep-water bottom longline, respectively.

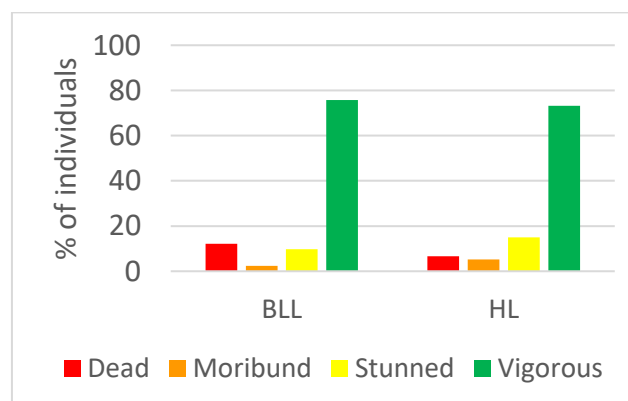


Figure 16. Vitality status of the blackspot seabreams sampled after catch with deep-water bottom longlines (BLL) and handlines (HL) in ICES sub-area X.



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Among the 413 blackspot seabreams specimens caught with deep-water bottom longline, 75.8% present a vigorous status similar from the blackspot seabreams caught with handlines (73.2%), and 9.7% of individuals were stunned when caught with deep-water longline, and 15.0% with handlines. The direct at-vessel mortality, including both dead and moribund individuals, for blackspot seabreams only represented 14.5% and 11.8% for bottom longlines and handlines respectively. In comparison, for blackbelly rosefish (*Helicolenus dactylopterus*) at-vessel mortality represented 62.8% of 1823 individuals sampled in bottom longlines and 25% of 16 individuals sampled in handlines, while splendid alfonsino (*Beryx splendens*) 87.9% of the 207 individuals sampled on bottom longlines were dead or moribund. The at-vessel mortality tend to be slightly higher for bottom longlines than for handlines, which could be due to the soaking time, which is higher in deep-water bottom longline. In fact, the longer fish are exposed to the fishing operation and fishing gear, the higher the potential effects are. They can lead to exhaustion and more intense physical damage.

Size-specific vitality state of blackspot seabream presents some variations between the fishing gear as showed in Figures 17 and 18 for handline and deep-water bottom longline, respectively, but all length classes displayed low direct at-vessel mortality.

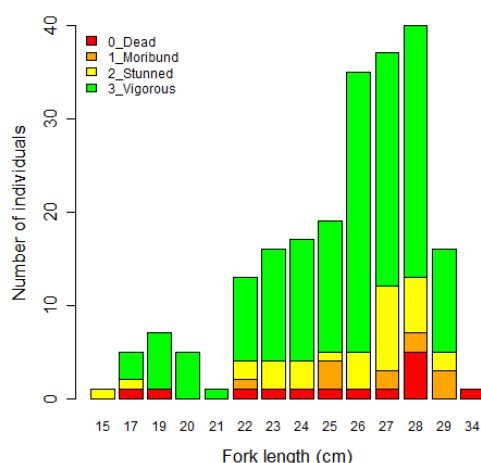


Figure 17. Size/specific vitality status of blackspot seabream caught with handlines in ICES sub-area X.



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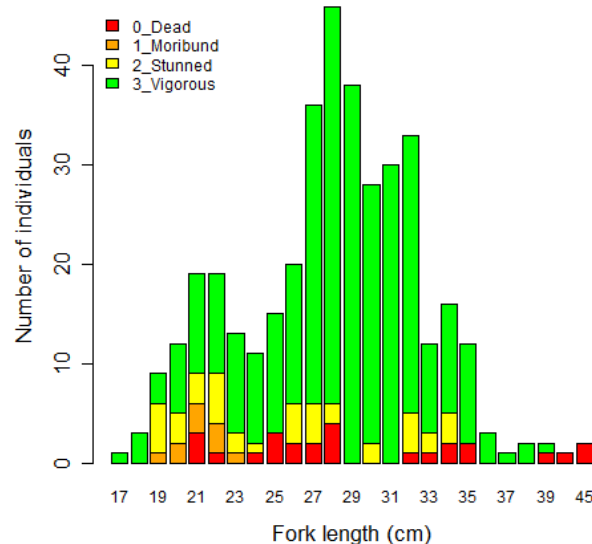


Figure 18. Size/specific vitality status of blackspot seabream caught with deep-water bottom longline in ICES sub-area X.

Among the individuals that were evaluated as vigorous or stunned ($n = 353$ and 188 for bottom longlines and handlines respectively), the number of individuals with lesions, badly hooked or badly handled in such a way their probability of survival was considered low, was very limited.

In the bottom longlines, all sampled individuals were hooked in the mouth, 1 was bleeding and 1 was injured in the body, and 6 individuals were hit on the vessel. To be conservative, those 8 individuals were added to the at-vessel mortality of bottom longlines, that totalled 16.5% in number of individuals. In the handlines, all individuals were hooked in the mouth, except 2 individuals that were hooked in the body or the eye with resultant lesions. No other lesions or bad handling was recorded. Accounting for those two individuals, the at-vessel mortality of handlines totalled 12.7% in number of individuals.



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II.III.II Post-capture survival / Captivity - in tank data

In the last 3 years (2015-2018), Flying Sharks collected 174 individuals of blackspot seabream ranged in size from 7-15cm fork length. Fish were always collected with hook and lines at depth down to 10m. The average husbandry time in the Aquário de Porto Pim was 21 days between collections and transport. From the 174 fish collected 17 (9.8%) developed exophthalmia or other health problems and were rejected while 157 (90.2%) survived to an average husbandry of 21 days and to an average transport duration of 36 hours. These results suggest that young blackspot seabreams collected with hook-and-lines at shallow waters display a very high rate of post-capture survival at captivity. Although it is not possible to directly translate these results into post-capture survival in commercial fisheries, this results may suggest that at least for fish below MLS that are quickly returned back to depth the survival rates can also be very high.

II.III.III. Post-release survival

II.III.III.I Mark-recapture data / Indirect survival estimation

Mark-recapture data to estimate recapture rates can indirectly help estimate survival rates. Since 1999 the Department of Oceanography and Fisheries of the University of the Azores is conducting a demersal fish tagging program across all the island slopes and some seamounts in the archipelago. During the annual demersal survey cruises, several species are regularly tagged with external (spaghetti) tags and released, and recapture data retrieved from scientific surveys or fishermen (Table V). The two most intensively tagged species – *Helicolenus dactylopterus* and *Pagellus bogaraveo* – show an average recapture rate around 3%, compatible with this type of tags. Average and maximum time at liberty of recaptured fish suggest long-term post-release survival.



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Table V. Results from mark-recapture program conducted in the Azores archipelago.

Species	Scientific name	Tagged	Recapture		Avg Time at liberty		Max time at liberty	
		n	n	%	days	years	days	years
Blackbelly rosefish	<i>Helicolenus dactylopterus</i>	12742	377	3	774	2,1	4830	13,2
Blackspot seabream	<i>Pagellus bogaraveo</i>	12104	338	3	466	1,3	4034	11,1
Other species		6741	132	2				

II.III.III.II. Telemetry data / Direct survival estimation

Telemetry data can directly help estimate survival rates of commercial and by-caught species. The University of the Azores has been conducting acoustic (passive/active) and satellite tagging programs since 2001 across the archipelago targeting a number of different species (Table VI).

Table VI. Results from the electronic tagging program conducted in the Azores archipelago. Recapture rates report the number of tagged individuals detected a minimum 8 days period after release.

Species	Scientific name	Tagged	Recapture (min. 8 days)	
		n	n	%
Blackspot seabream	<i>Pagellus bogaraveo</i>	155	105	67
Kitefin shark	<i>Dalatias licha</i>	25	24	96
Bluntnose sixgill shark	<i>Hexanchus griseus</i>	6	6	100
Wreckfish	<i>Polyprion americanus</i>	11	6	55
Blue shark	<i>Prionace gauca</i>	37	37	100



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Tope shark	<i>Galeorhinus galeus</i>	2	2	100
Hammerhead shark	<i>Sphyrna zygaena</i>	17	14	88
Common seabream	<i>Pagrus pagrus</i>	27	26	96
Dusky grouper	<i>Mycteroperca marginatus</i>	11	11	100
Blacktail comber	<i>Serranus atricauda</i>	9	9	100
White trevally	<i>Pseudocaranx dentex</i>	32	29	90
Parrotfish	<i>Sparisoma cretense</i>	22	22	100

Post-release mortality estimates are typically made by holding the catch in a tank, pen or cage for short-term monitoring (e.g. 48 h) (Raby *et al.*, 2013). Yet, these estimates may be inaccurate in some cases because they fail to integrate the challenges of the wild environment. Most obvious among these challenges is predator evasion. Stress and injury from a capture experience can temporarily impair physiological capacity and alter behaviour in released animals, a period during which predation risk is elevated. Electronic tagging recapture rates identify potential survival directly. Most likely, they will even underestimate real survival, as it will not account for animals away from acoustic receivers or with damaged/unreporting tags.

The data presented here represent high potential for fishery exemptions to the LO via directly demonstrated high survival rates of (properly) discarded fish. These (relatively) high survival rates are even more noteworthy as they include various deepwater fishes, notably the blackspot seabream, which are typically seen as species with very limited potential survival given their physiological/decompression complications upon the fast hauling.



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PART III. CONCLUSIONS

Current knowledge confirms that the hooks-and-lines demersal fisheries such as those making up the bulk of the Azorean catch in the last decades are far more selective and generate substantially less discards than demersal trawl fisheries. The levels of discarding of deep-water demersal or semi-pelagic longlining in the Azores and elsewhere are generally much lower than those in European deep-sea demersal trawling for fishes or crustaceans, which range from 20%-70% (Allain *et al.*, 2003; Borges *et al.*, 2001; Connolly and Kelly, 1996; Fernandes *et al.*, 2015; Grazia Pennino *et al.*, 2014; Holley and Marchal, 2004; Kelleher, 2005). Within the Azores deep-water bottom hook-and-line fishery, discarding in handlining is even smaller than in longlining (A. Canha, pers. comm.), just like the global estimates for handlining (2.0%; Kelleher, 2005), but disentangling catch from these two gears is complicated because they are multi-specific and mostly similar.

As to the trustworthiness of the discard estimation in Azores fisheries, a wide range and diversity of discards data have been collected in the Azores, including onboard observer programmes in the main fisheries. In most cases, sampling covered a wide spectrum of fishing characteristics and conditions and are thus considered representative of the fishing activity and discarding practices.

The sustainability of deep-sea fisheries can only be achieved in rare occasions but more likely so when using artisanal small-scale passive gears (Norse *et al.*, 2012), as it is the case in the Azores.

Onboard observer data are a very reliable yet costly way of assessing total catch, which as the present study highlights, is substantially higher than the official reported catch.



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