Stock Annex: Blackspot seabream (*Pagellus bogaraveo*) in Subarea 10 (Azores grounds)

Stock:	Blackspot seabream
Working Group:	Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)
Created:	
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Last updated:	February 2010
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A. General

A.1. Stock definition

"Stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. ICES considered three different components for this species: a) Areas 6, 7, and 8; b) Area 9, and c) Area 10 (Azores region). This separation does not pre-suppose that there are three different stocks of red (blackspot) seabream, but it offers a better way of recording the available information" (ICES, 2007).

In fact, the inter-relationships of the red (blackspot) seabream (*Pagellus bogaraveo*) from Subareas 6, 7, and 8, and the northern part of Division 9.a, and their migratory movements within these sea areas have been confirmed by tagging results (Gueguen, 1974). Possible links between red (blackspot) seabream from the Azores region (Subarea 10) with the others areas are not yet fully studied. However, recent studies show that there are no genetic differences between populations from different ecosystems within the Azores region (East, Central and West group of Islands, and Princesa Alice bank) but there are genetic differences between Azores (ICES Subarea 10) and mainland Portugal (ICES Division 9.a) (Stockley *et al*., 2005). These results, combined with the known distribution of the species by depth and tagging information, suggest that Subarea 10 component of this stock can be considered as a separate management unit.

A.2. Fishery

Blackspot sea bream has been exploited in the Azores (Subdivision 10.a2), at least, since the 16 century, as part of the demersal fishery (Silva and Pinho, 2007).

The Azorean fishery is a multispecies and multigear/fleet one (demersal mixed hook and lines). About 104 species belonging to 49 families were caught and identified during the spring demersal longline surveys from 1995–2006 (Menezes *et al.,* 2006). This demersal community is structured by assemblages according depth (Pinho and Menezes, 2005; Menezes *et al.,* 2006). Three main assemblages can be defined according depth: Shallow (<200 m), Intermediate (200–700 m) and Deep (>700 m). The key species of this fishery is red (blackspot) seabream (*Pagellus bogaraveo*) and bluemouth (*Helicolenus dactylopterus*), which are distributed from shallow (<50 m) to deep depth strata (1000 m). The fishery is also considered as small-scale because the highest proportion (about 80%) comprises small vessels (<12 m).

The directed fishery is a mixed hook and line fishery where two components of the fleet can be defined: the artisanal (handlines) and the longliners. The artisanal fleet is composed of small open (sometimes closed) deck boats (<12 m) that operate on local areas near the coast of the islands using several types of handlines and covering depth until 800 m. Longliners are closed deck boats (>12 m) that operate in all areas (except within 3 miles of island coasts), including banks and seamounts (Pinho and Menezes, 2005; Silva and Pinho, 2007; Pinho and Menezes, 2009). In the past, the tuna fishery has also caught juveniles (age 0) of blackspot sea bream for use as live bait, in a seasonal and irregular way, depending on tuna abundance and on the occurrence of other preferred bait species, like *Trachurus picturactus* (Pinho *et al*., 1995). This practice has been reduced significantly during the last decade, particularly since the introduction of the TACs.

The operational regime of each vessel type varies considerably. Small open-deck vessels usually operate in areas near the coast, using mainly handlines. They make daily trips and target mainly shallow (<200 m) and intermediate (200–700 m) depth species (see Pinho and Menezes, 2005). On average, this component makes between 70 to 150 fishing days per year, depending on the island base of the vessel. Some open-deck vessels (9–12 m) based in St Miguel Island operates in a larger area including banks near the coast (to 50 miles). These vessels make about 200 fishing days per year. Small closed-deck vessels (<14 m) are considered the main component of the fleet targeting deep-water species and cover almost all areas and depth strata. They use mainly deep longlines and handlines, operating in coastal areas of the islands and in the main banks and seamounts. These vessels operate in all strata but preferentially target species from 200–800 m strata, making on average between three and seven fishing days per trip, with one set a day, though occasionally more, using from six to ten thousands hooks by set. On average they make about 200 fishing days per year. Industrial vessels operate mainly on banks and seamounts, inside or outside the EEZ, including the ICES and CECAF areas, using deep longlines. They usually fish in the intermediate (200–700 m) and deepwater strata (>700 m). These vessels make trips, on average of seven days, with one (or more) sets a day of about 14 000 hooks per set. They make on average 250 fishing days per year. However, the fleet exhibits a very high level of absenteeism (many vessels operate on a no- regular basis and with many interruptions in landings with time), particularly for the small vessel size component, probably related with the subsistence characteristic of this component where the fishers are also farmers.

Although the predominant gears are the demersal longline and handlines, the fleet, particularly the local open (or close) deck component, is very plastic and can operate opportunistically and on seasonal way to other species like crustaceans (using traps), small pelagic (using nets) and squids or tunas (live and bait), as a function of abundance and price (Pinho and Menezes, 2009). Each vessel usually has permits to use different gears.

A.3. Ecosystem aspects

The red blackspot seabream is found in the northeast Atlantic, from south of Norway to Cape Blanc, in the Mediterranean Sea, and in the Azores, Madeira, and Canary Archipelagos (Desbrosses, 1938; Pinho and Menezes, 2005). Hareide (2002) reported also occasional occurrence of this species along the Mid-Atlantic Ridge (north and south of the Azores). The Azores region (Subdivision 10.a2) is considered a management unit based on genetic studies and tagging data (ICES, 2007).

Blackspot seabream is a benthopelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. The vertical distribution of this species varies according to individual size and season of the year. In the Azores, this species is found in all habitats (coastal areas of islands, banks, and seamounts) down to 900 m depth. Local distribution is directly correlated with depth, with juveniles inhabiting littoral and shallow waters (0–30 m), young immature individuals inhabiting depths less than 300 m, and large adults inhabiting areas between 300–700 m depth (Menezes *et al.*, 2005).

Blackspot seabream undertakes a vertical spawning migration, with the adults moving from deeper to shallower waters during the spawning season (December–March) and forming aggregations (Krug, 1990; 1998). The dynamic of the spatial distribution in the Azores region is not yet very well understood. Data from the survey show that juveniles (age 0–1 years) are almost absent from the main seamounts, but are found in the coastal areas throughout the year, suggesting area interactions (Pinho, 2003).

The Azores is an oceanic region where the deep-water ecosystem is predominant. The major topography feature is the mid-Atlantic Ridge (MAR) which follows a sinuous course southwards from Iceland to the Azores. Islands and seamounts are other prominent topographic features, which are characterized by very specific circulation patterns and play an important role in the ocean biological system (Bashmachnikov *et al.*, 2005; 2009a; 2009b; Silva and Pinho, 2007, Morato *et al.*, 2008). This ecosystem is poorly known and important dynamics of the *Pagellus bogaraveo* population are dependent of environmental dynamics at different scales.

The essential fishing habitat of *Pagellus bogaraveo* comprises littoral and deep-water areas. The distribution of this habitat around the Azores is much discontinued.

B. Data

For this species data is available from commercial fisheries and from surveys reported to ICES. Data from commercial fisheries include landings (auction data) and biological port sampling. There are also inquiries and logbooks and observers (from large longliners) available to compute fishing effort.

Annual landings are computed from the diary sales of fresh fish on the auctions. Landing information does not include discards. Biological sampling is made on the most important fisheries ports, which usually incorporate an inquiry to the captain. From these data are computed the annual fishery length composition and fishing effort. Standardized catch rates, exploring several explanatory variables (year, port, season and vessel type), have been estimated since 2006.

Biological fishery data, including aging and maturity, are available and have been collected annually since 2002, under the EU data collection regulation, and since 2009, under the EU Data Collection Framework.

Demersal longline survey data are available since 1995 (Pinho, 2003; Menezes *et al.*, 2006). An annual abundance index and biological data (length composition, sex, age and maturity) from the survey are available and the time-series have been presented to WGDEEP.

Data are supplied from databases maintained by Department of Oceanography and Fisheries (DOP/UAç). An informatics routine to compute these basic output data specific for the WGDEEP is under development.

The data used in the assessments are considered as the best available data at the Working Group time of the year.

B.1. Commercial catch

Landings data (in weight and value) from the Azores have been reported to ICES. Landings are collected directly from the first sale of fresh fish at the auctions. Information on discards has been collect in recent years, but it is not relevant for red (blackspot) seabream because the species is rarely discarded.

Complete official landings are available since 1982; however detailed landings by vessel are only available since 1990. An incomplete time series from 1948 is available to be used for illustrative development of the fishery.

Landing data disaggregated by gear type, area and depth are lacking or are incomplete.

B.2. Biological

The information available for *Pagellus bogaraveo*, Azores ICES Subdivision 10.a2, is presented in Table 1.

Annual length composition from the fishery (1990–2008) and survey (1995–2008) are available. In general length composition covers a range of lengths from 10 to 57 cm with a mode around 30 cm.

Pagellus bogaraveo is a protandric hermaphrodite species changing from males to females. Sexing and staging this species may be sometimes problematic because macroscopic scales are not validated with microscopic observations.

Spawning in Subdivision 10.a2 occurs from December to March, with a mode on Janury/March.

Maturity information is only available for some periods (1982-1986, 1991 and 2002–2008).

Red (blackspot) seabream is considered a slow-growing species. Gueguen (1969) reported a maximum age of 20 years, Ramos and Cendero (1967) and Coupé (1954) reported 12 years, Sanchez (1983) reported 10 years, Ana *et al* (2006) reported 9 years and Gil and Sobrino (2002) reported 8 years. In the Azores a maximum age of 15 years was observed in a 56 cm length fish (Krug, 1994). However, no age validation was obtained by examining structures from fish of a known age (e.g. from mark-recapture studies with conventional tags or tetracycline method).

Aging data are available from the fishery and from surveys. Annual ALKs are available for the survey (1996–2008) and fishery (2002–2008). Growth parameters have been estimated for sex combined (Pinho *et al.*, 2006).

B.3. Surveys

Survey data available from the Azores for *Pagellus bogaraveo* is resumed in Table 1.

The Azorean longline survey was conducted annually each spring (usually from April to June) from 1995 to 2008, with exception of the years 1998 and 2009. The survey followed a stratified design (6 statistical areas and 12 depth strata) and covered the Azores archipelago around the islands, banks, and major seamounts (Figure 1). The survey is design for abundance estimation of red (blackspot) seabream, covering the depth strata from 50 to 600 m. Depth coverage was extended

to 800 m since 2004. Additionally, depths from 800 to 1200 m are covered in one transept by statistical area for ecological studies. Details of the survey design can be found in Pinho (2003) and Menezes *et al.* (2006).

The catch per hook value (cpue) was calculated for each species, area, and station stratum, and an index of relative abundance in number (RPN) (or weight-RPW) was obtained by multiplying each of these cpue values by the corresponding area size. The average RPN value for each area and stratum was then calculated. The abundance values for each area and for the Azores were computed by summing the abundance index values across strata and across areas, respectively.

Length data were collected for all survey years following a random stratified design. Length samples were stratified by station, statistical area and depth strata, and then weighted by the area-stratum size. The resultant length distributions were averaged within each area-stratum and summed across strata and areas to estimate total length frequency.

B.4. Commercial cpue

Nominal commercial catch rates are estimated by trip from the fishery landing enquiries data, collected by interviews with the fishermen during landing. So, the catch data for each trip correspond to the landings information collect by the auction market. The effort data are recorded by shore based samplers that inquire the fishing masters in order collect detailed information on fishing operations, including the number of hooks per set, number of sets per trip, gear characteristics, etc. Each record also includes information on date, geographical area of the catch and catch in weight for each species landed. The total fishing effort per trip is usually estimated as the product of the mean number of hooks per set multiplied by the number of sets per trip. Nominal catch rates were estimated as the kg of blackspot seabream caught per 1000 hooks.

This catch rates are affected by the abundance but also by other factors, like season, gear configuration, boat type and fishing target species. The effects of the different factors in the catch rates have been estimated, using GLM-generalized linear models, since 2006 (Pereira, 2006). This standardized cpue covered the considered "fully exploited phase" of the fishery (since 1990) and presented a relatively stable trend. There is no information available for the ancient times of the fishery.

B.5. Other relevant data

C. Historical stock development

The first attempt to assess the resource was performed during 1996 SGDEEP meeting using the SVPA and Laurec-Shepherd on the matrix of catch-at-age from the period 1982–1993 and the Azorean effort fleet. Concerns related to the annual age compositions, maturity ogives and lack of convergence were expressed and the assessment was not validated (ICES, 1996). A new attempted was made during the 2006 WGDEEP meeting using Separable VPA, Ad hoc VPA tuning and XSA (ICES, 2006). The results from the exploratory assessment performed in 2006 were considered unreliable.

Agreed data and assessment at the Benchmark (WKDEEP, 2010).

Annual landing data from 1990 and onwards and standardized cpue from 1990 and onwards. Standardized fishery cpue derived by applying the GLM delta lognormal model distribution to inquiry data (landing and effort data by trip and vessel).

Azorean longline survey abundance indices from 1995–onwards.

Annual survey length compositions abundance by area from 1995–onwards.

This assessment unit is assessed based on i) trends in the mean length of mature and immature from longline survey using the entire survey area and individual survey statistical areas; ii) trend in abundance in survey and standardize commercial cpue series.

For the survey data indices of abundance (cpue weighted by the area size) by length classes were computed. These annual data was then disaggregated by sexes assuming a sex change dynamic proposed by Krug (1990; 1998). The sexes include: Females, males, hermaphrodites and undifferentiated.

To split the annual length composition by sex the following equations were used to describe the sex-ratio of each sex:

$$P = \frac{1}{1+e^{(6.56-0.1816*LF)}} \quad \text{Females}$$

$$P = \frac{1}{1+e^{(-5.180+0.227*LF)}} \quad \text{Males}$$

$$P = 0.388*(-23.688+LF)e^{\left[-0.225*(-23.688+LF)\right]} \quad \text{Hermaphrodites}$$

$$P = e^{(16.68-0.71*LF)} \quad \textit{Undifferentiated}$$

Where P is the proportion of each sex category and LF is the fork length.

To split these annual length compositions by mature and immature length compositions the following maturity ogives for males and females were adopted:

$$P = \frac{1}{1+e^{(-21.43+0.66*LF)}} \quad \text{Females}$$

$$P = \frac{1}{1+e^{(-13.46+0.476*LF)}} \quad \text{Males}$$

Where P is the proportion of mature of each sex and LF fork length.

$L_{50\%\ values}$ derived from the ogives calculated as above were 28 cm for males and 32 cm for females. A mid-point between these two values was assumed for hermaphrodites. A knife edge was adopted to separate mature from immature fish by sex type (see Table below).

SEX	MATURE	IMMATURE
Males	> 28 cm	< 28 cm
Females	> 32 cm	< 32 cm
Hermaphrodites	> 30 cm	< 30 cm
Undifferentiated	-	All

This analysis should be carried out for the entire survey area and survey statistical areas.

D. Short-term projection

No short-term projection is conducted for this stock.

E. Medium-term projection

No medium-term projection is conducted for this stock.

F. Long-term projection

No long-term projection is conducted for this stock.

G. Biological reference points

Tools available from the WKLIFE were explored during 2011 meeting;

- YPR using FLR code (BHAC). The input parameters: Loo=56.7, K=0.13, To=-1.96, M=0.2, cm(L_{mat}/L_{inf})=0,5 and c(Lc/L_{inf})=0,5).
- Z was estimated from a catch curve applied to the fishery length frequency or age data.
- Froese and Binolhan, 2000 method assuming the mean fishery length composition over the period 1995 to 2010.
- Results from WKLIFE Gislason spreadsheet were applied using an L_{max} of 63 cm and AFC = 4.

METHOD	AFC	LMAX	LINF	K	TO	AGE MAT	FMAX	F0.1	F20%	F30%	F35%	F40%
Gislason spreadsheet	4	63	65,27	0,22	-	2,6	0,75	0,29	1,28	0,58	0,44	0,35
BHAC	4		56,7	0,13	-1,46	4	-	0,30	0,59	0,35	0,28	0,23

Results are summarised on the table. Both methods estimate similar value of $F_{0.1}$, however BHAC tends to underestimate the estimates of the others reference points due to the different growth parameters adopted. $F_{40\%}$ or $F_{0.1}$ seems to be the appropriate F_{MSY} proxy for the species corresponding to a fishing mortality of between F=0.2 and 0.3 respectively.

The Z estimates from the catch curve fall within the range 0.4 to 0.7. A mean value of Z=0.5 was adopted, corresponding to a current F=0.3.

Results from yield per recruit suggest that the stock is fully exploited with the actual F at the level of $F_{0.1}$.

Based on new information from tagging results from other area (9.a) it is considered that the growth parameters used in this analysis may be overestimated.

H. Other issues

I. References

Anna C., G. Petrakis and Tsamis evaggelos. 2006. Aspects of the biology of blackspot seabream (*Paqgellus bogaraveo*) in the Ionian Sea, Greece. Fisheries Research, 77:84–91.

Coupé, R. 1954. Cinquème note sur les Sparidés de la côte marocain, *Pagellus centrodontus*, (Val. 1836). Journal du Conseil Permanent International pour L`Exploration de la Mer, 11 pp.

Desbrosses, P. 1938. La dorade commune (*Pagellus centrodontus*) et sa pêche. Revue du Travail de l`Office des Pêches maritime, 5 (2): 167–222.

Bashmachnikov, I., Lafon, V., and Martins, A. 2005. Sea Surface Temperature Variability in the Subtropical North-East Atlantic. 31st International Symposium on Remote Sensing of Environment (ISRSE). 20–24 June.2005, StPetersburg. WWW site

Bashmachnikov, I., Mohn ,C., Pelegri, J.L., Martins, A., Machin, F., Jose, F., and White, M. 2009a. Interaction of Mediterranean water eddies with Sedlo and Seine seamounts, Subtropical Northeast Atlantic. Deep-Sea Research II, Vol. 56:25, 2593–2605.

Bashmachnikov, I., Martins, A., and Mendonça, A. 2009b. In-situ and remote sensing signature of three meddies east of the Mid-Atlantic ridge. Journal of Geophysical Research (2008JC005032: accepted).

Gil, J. and Sobrino, I. 2002. Update of the information about the red seabream (*Pagellus bogaraveo*) from the strait of Gilbraltar (ICES Ixa south). ICES WGDEEP 2002 Working Doc.

Gueguen, J. 1969. Croissance de la dorade, *Pagellus centrodontus* Delaroche. Revue du Travail de l´ Institut des Pêches Maritimes, 33 (3): 251–254.

Hareide NR and Garnes G. 2001. The distribution and catch rates for deep-water fish along the Mid-Atlantic Ridge from 43 to 61°N. Fish Res 51:297–310.

ICES. 2007. Report of the Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources. ICES CM 2004/ACFM:20.

ICES. 1996. Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources. ICES CM 1996/Assess:8.

Krug, H. 1990. The Azorean blackspot seabream, *Pagellus bogaraveo* (Brunnich, 1768) (*Teleotei, Sparidae*). Reproductive cycle, hermaphroditism, maturity and fecundity. Cybium, 14:2: 151–159.

Krug, H. 1998. Variation in reproductive cycle of the blackspot seabream, *Pagellus bogaraveo* (Brunnich, 1768) in the Azores. Arquipélago. Life and Marine Sciences. 16A:37–47.

Meneses, G. M., M. F. Sigler, H. M. Silva, and M. R. Pinho. 2006. Structure and zonation of demersal and deep-water fish assemblages off the Azores Archipelago (mid-Atlantic). Marine Ecology Progress Series, 324:241–260.

Morato, T., M. Machete, A. Kitchingman, F. Tempera, S. Lai, G. Menezes, R.S. Santos and T.J. Pitcher. 2008. Abundance and distribution of seamounts in the Azores. *Marine Ecology Progress Series*, 357: 17–21. doi:10.3354/meps07268.

Pereira *et al*., 2006. Standardized catch rates in number and weight for the Blackspot seabream (*Pagellus bogaraveo*) from the Azores longline fishery. WGDEEP working document, WD15b, Vigo, 2006.

Pinho, M. R., J. Pereira and I. Rosa. 1995. Caracterização da pesca do isco da frota atuneira Açoreana. *Arquivos do DOP, Série: Estudos*, nº 2/95, 29p.

Pinho, M. R. 2003. Abundance estimation and management of Azorean demersal species. PhD thesis. Department of Oceanography and Fisheries, University of the Azores, Horta, Portugal, 163 pp.

Pinho, M.R. and Menezes, G. 2005. Azorean Deepwater Fishery: Ecosystem, Species, Fisheries and Management Approach Aspects. *Deep Sea 2003: Conference on the Governance and Management of Deep-sea Fisheries*, Conference Poster and Dunedin Workshop Papers. FAO Fish. Proc. 3/2.

Pinho, M. R., Krug, H. and Pereira, J. G. 2006. Data evaluation for the assessment of red black spot seabream (*Pagellus bogaraveo*) from ICES Area X (Azores). ICES W.D.15-H, WGDEEP, Vigo 2006.

Pinho, M. R. and Menezes, G. 2009. Pescaria de demersais dos Açores. Boletim do Núcleo Cultural da Horta 2009:85-102. ISSN 1646–0022.

Ramos, F. and O. Cendero. 1967. Notes on the age and growth of *Pagellus cantabricus* (Asso) of Northern Spain. ICES CM 1967/G: 3. 8 pp.

Rosa, A. (*in prep*). Demersal fish assemblages off the Azores: spatio temporal patterns and trends.

Sanchez, F. 1983. Biology and fishery of red sea-bream (*Pagellus bogaraveo*) in VI, VII and VIII Subareas of ICES. ICES CM 1983/G:38. 15 pp.

Silva, H. M. and Pinho, M. R. 2007. Small Scale Fisheries in Seamounts (Chapter 16), 335–360. In: Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds.) Seamounts: Ecology, Conservation and Management. Fish and Aquatic Resources Series, Blackwell, Oxford, UK, p. 533.

Stocey, B., Menezes, G., Pinho, M. R., Rogers, A. D. 2005. Genetic population structure in the black-spot sea bream (Pagellus bogaraveo Brunnich, 1788) from NE Atlantic. Marine Biology, 146: 793–804.

Table 1. Time-series from fishery and survey available for the assessment of *Pagellus bogaraveo*, ICES, Area X. Data in brackets refers to a period.

DATA	FIHERY	SURVEY
Length composition (sex combined)	1990–2008	1995–2008
ALK (otholits)	(2002–2008)	1995–2008
Maturity ogives	(1982–1986); 1991; (2002–2008)	-
Sex-ratio	Same as maturity ogives	1995–2008
Abundance index	1990–2008	1995–2008
Landings (weight)	1980–2008	-

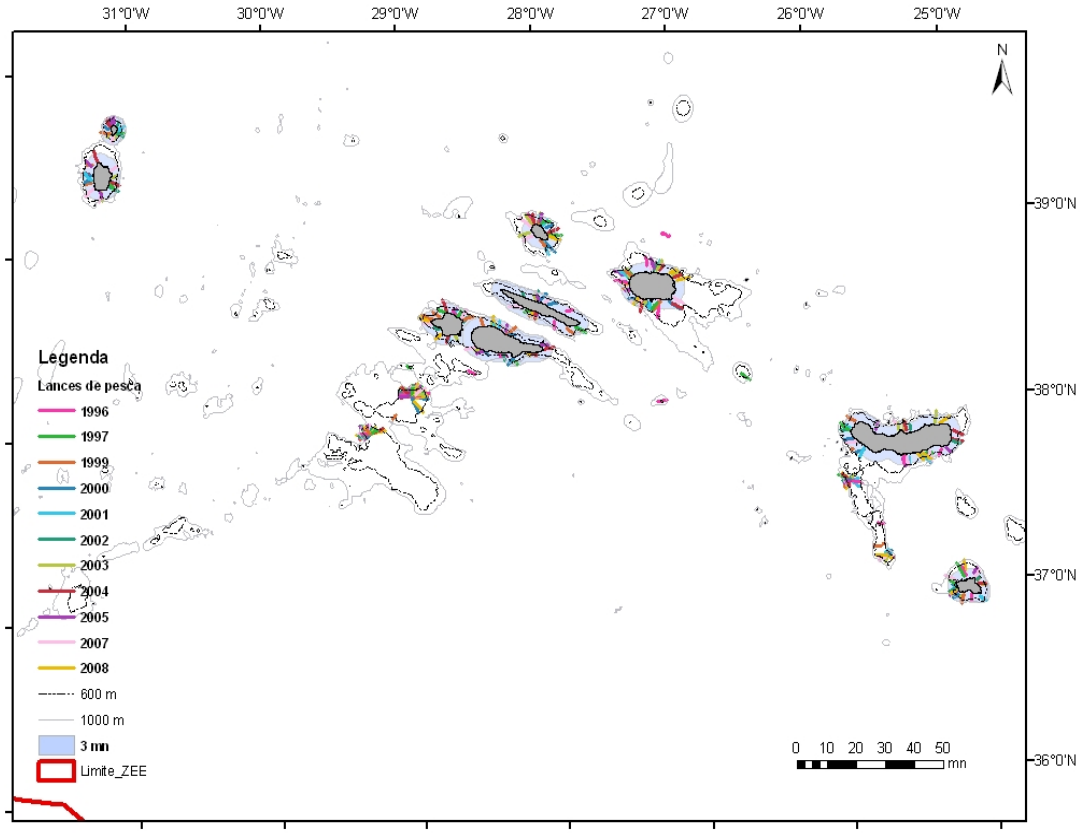

Figure 1. Statistical areas covered by the Azorean Spring Demersal Longline Survey. Annual transepts are represented on the graph for illustration. The 3 miles (shadow) island coast box area and the 600 m and 1000 m contour are also shown. Adapted from Rosa (1999).