https://doi.org/10.17895/ices.pub.18622079

Stock Annex: Blackspot seabream (*Pagellus bogaraveo*) in Subarea 9 (Atlantic Iberian waters)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Blackspot seabream
Working Group:	Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)
Created:	
Authors:	Juan Gil Herrera – WGDEEP
Last updated:	May 2019
Last updated by:	Juan Gil Herrera – WGDEEP

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 blackspot seabream, but it offers a better way of recording the available information" (ICES, 2007). The inter-relationships of this species from Areas 6, 7, and 8, and the northern part of Area 9.a, and their migratory movements within these areas have been observed by tagging methods (Gueguen, 1974). However, there is no evidence of movement to the southern part of 9.a where the main fishery currently occurs. Tagging has been done also in the Strait of Gibraltar area, where the majority of the fishery currently occurs. No significant movements are reported, although local migrations are also observed: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain in this area as a resident population (Gil, 2006). In 2007, Piñera *et al*. suggests no significant genetic differences are present along Spanish coasts (Mediterranean and Atlantic areas).

Stock structure of the species in ICES Subarea 9 still unknown. Besides, in the case of the Strait of Gibraltar, blackspot seabream also inhabit in Morocco waters. In fact recaptures of tagged fish were also notified by Moroccan fishermen.

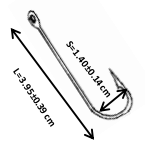
A.2. Fishery

Although *Pagellus bogaraveo* is caught by Spanish and Portuguese fleets in Subarea 9, only a more complete description of one of the fisheries has been provided to the Working Group, the corresponding to the Spanish fishery in the southern part of Subarea 9, close to the Strait of Gibraltar.

The majority of landings on deep-water species at mainland Portugal are conducted by the artisanal fleet, mainly longline fisheries. These operated in the Portuguese continental slope and located in ports as Peniche, Sesimbra and Sagres. Blackspot sea bream landings reflect a seasonal activity probably related with a larger availability of the species or market demands that lead fishermen to spend some time targeting this species (I. Figueiredo, *pers. com*.) and/or could reflect differences on the species' availability or differences dues to skippers' seasonal fishing grounds preferences (Aráujo *et al*., WD to the WGDEEP 2017).

In relation to the Spanish fishery in the southern ICES Subarea 9a, an updated description of it has been presented to the Working Group by Gil *et al*. (WD to the 2019 WGDEEP), that complete the information offered in the previous WGs (Gil *et al*., 2000, 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018; Gil and Sobrino, 2001, 2002 and 2004). This artisanal longline fishery targeted Red sea bream has been developed along the Strait of Gibraltar area. In recent years this fishery covers more than the 70% of the landings for the species in the Subarea 9. The base and landing ports are two: Algeciras and mainly Tarifa (Cádiz, SW Spain). The "*voracera*", a particular mechanised hook and line baited with sardine, is the gear used by the fleet (Table A.2.1). The mean technical characteristics of this fleet by port are 8.95 and 6.52 meters length and 5.84 and 4.0 tons G.T.R. for Tarifa and Algeciras, respectively (Gil *et al*., 2000). Currently around 60 boats are involved in the fishery. Fishing grounds are located at both sides of the Strait of Gibraltar and quite close to the main ports (Figure A.2.1). Fishing is carried out taking advantage of the turnover of the tides in depths from 200 to 400 fathoms. Landings are distributed in categories due to the wide range of sizes and to market reasons (these categories have varied in time but from 2000 onwards still the same).

Table A.2.1. Blackspot seabream Spanish fishery of the Strait of Gibraltar: Fleet and gear summary descriptive.

FLEET ID	GEAR TYPE	N° BOATS	NUMBER OF LINES	HOOK TYPE AND SIZE	MEAN SOAKTIME	EFFORT (DAYS AT SEA)
LHM_DEF	Vertical mechanized handline ("voracera")	±60	Maximum of 30 lines per day (each line attached a maximum of 100 hooks, usually ±70)	L=3.95±0.39 cm S=1.40±0.14 cm 	±30 min	Maximum 140 days

From 2002 onwards artisanal boats from other port, Conil, have begun to direct its fishing activity to *P. bogaraveo* in different fishing grounds and with different fishing gear

(longlines) than the "*voracera*" fleet boats. Nowadays, only around s9 boats are developing this fishery.

In addition, Moroccan longliners have been fishing in the Strait of Gibraltar area since 2001. Around 102 boats are mainly based in Tangier and their average technical characteristics are: 20 GRT, 160 CV and about ten years old. Moreover, 435 artisanal boats (±15 CV, ≤2 GRT and 4–6 m length) also target this species in the Strait of Gibraltar area (S. Benchoucha, *pers.com*.). The WG considers the account of Moroccan data appropriate as the fishery operates in the same area as the Spanish fishery and obviously targets the same stock. Unfortunately, no updated information was available in 2015 and no new information from the Moroccan fishery has been received in the last three years.

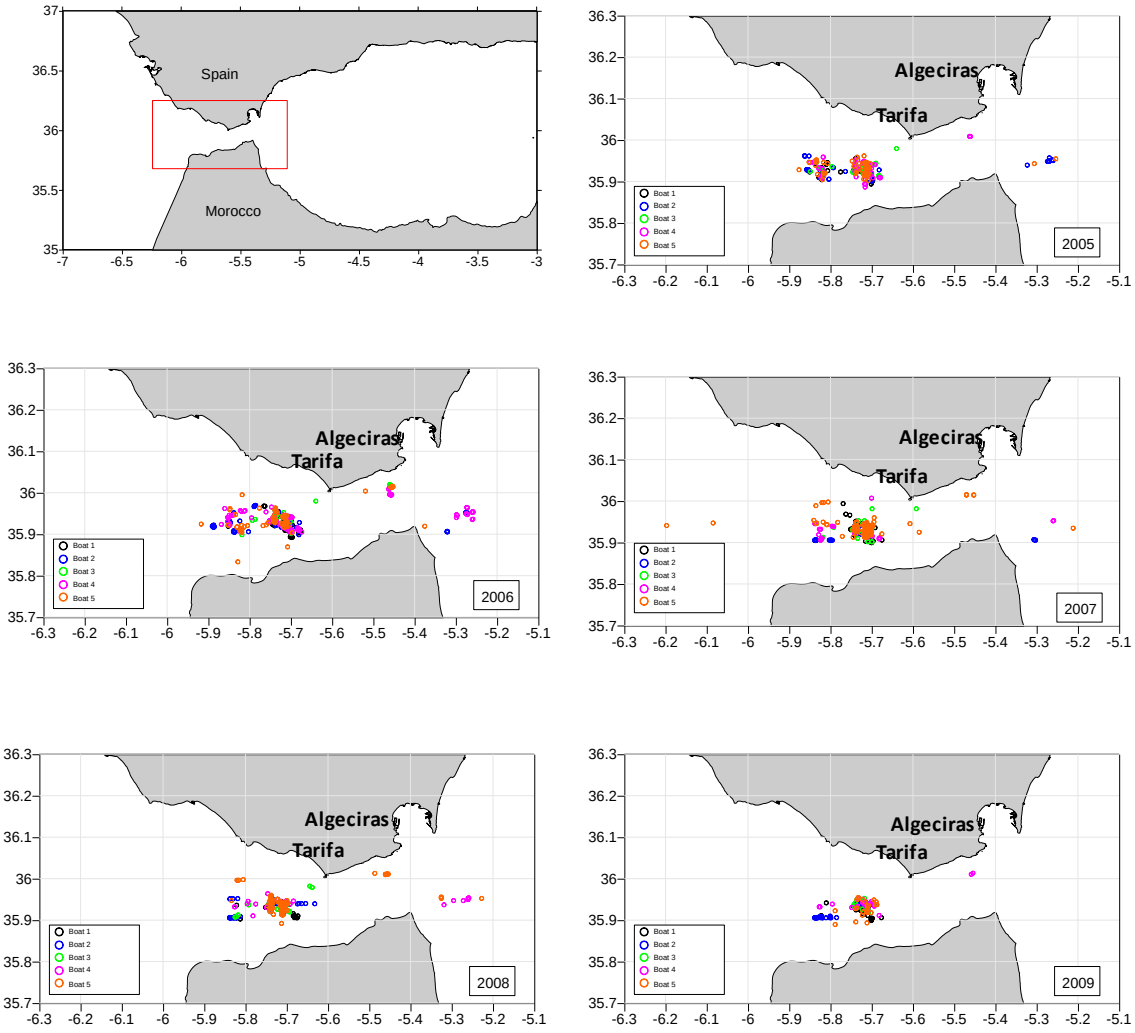
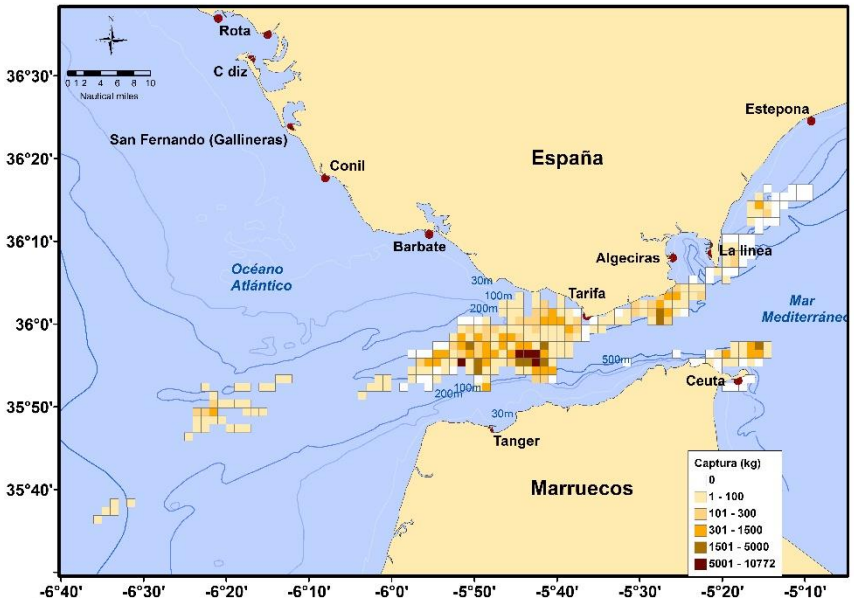
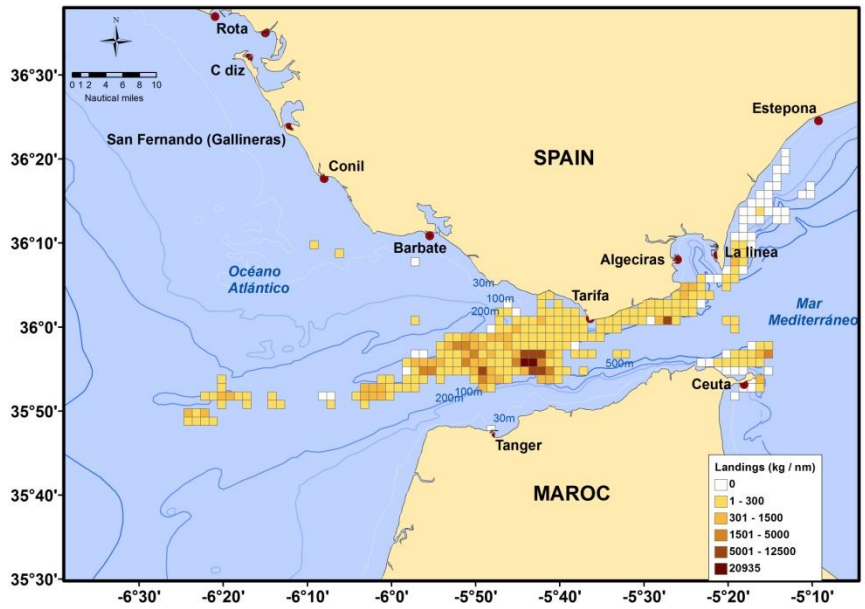


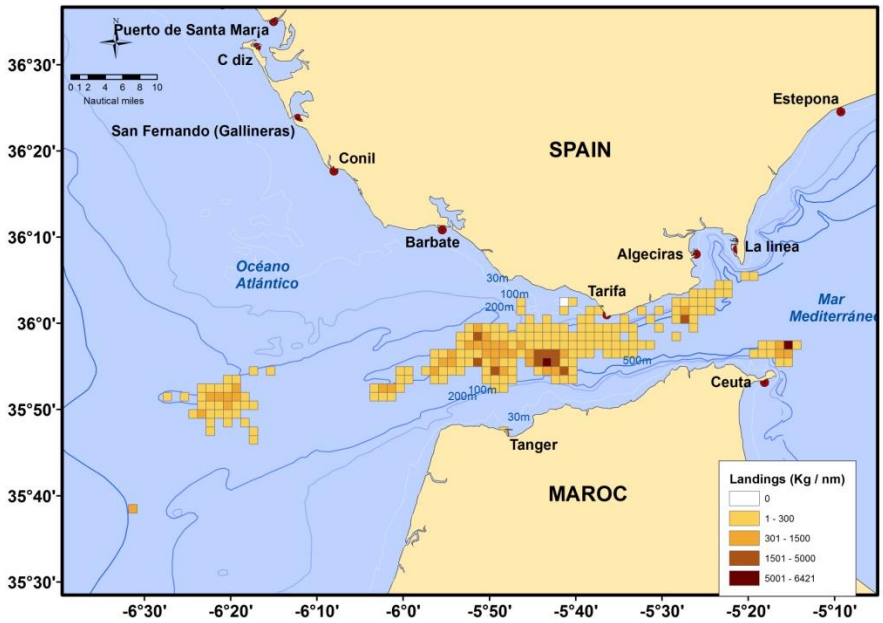
Figure A.2.1. Blackspot seabream Spanish fishery of the Strait of Gibraltar: Yearly soaking positions footprints from observers on-board programme (from Gil *et al.*, WD to the 2011 ICES WGDEEP).

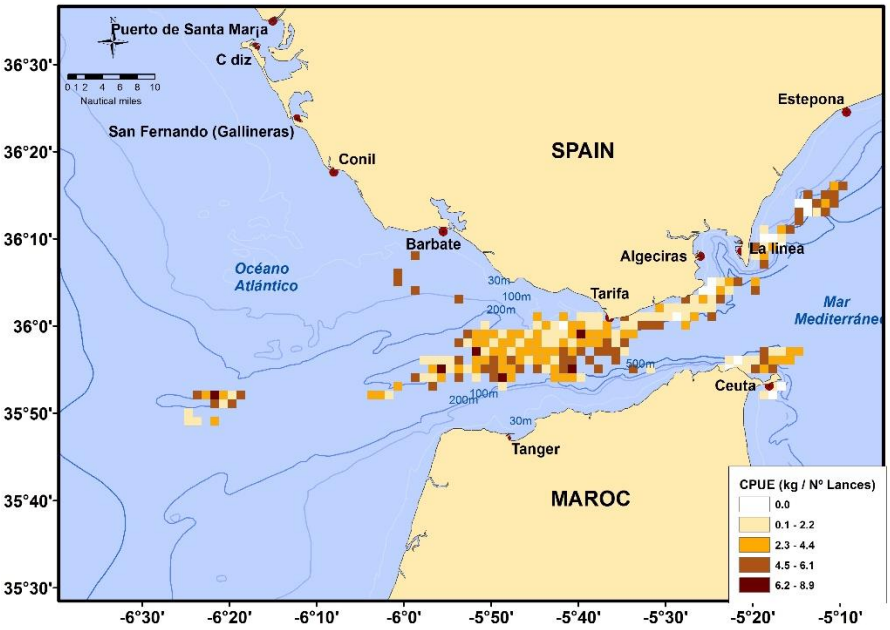
It should be noted that not all the catches/landings from Strait of Gibraltar do not come exclusively from ICES Subarea 9: however it was considered from the same stock unless the

fishing area is placed between different Regional Organizations/Commissions (ICES, GFCM and also CECAF) borders (Figure A.2.2).






Puerto de Santa Maria
C diz
0 1 2 4 6 8 10
Nautical miles
San Fernando (Gallineras)
Conil
SPAIN
Estepona
Barbate
Algeciras
La linea
Océano Atlántico
30m
100m
200m
Tarifa
Mar Mediterráne
500m
Ceuta
Tanger
MAROC
Landings (Kg / nm)
0
1 - 300
301 - 1500
1501 - 5000
5001 - 6421
36°30'
36°20'
36°10'
36°0'
35°50'
35°40'
35°30'
-6°30'
-6°20'
-6°10'
-6°0'
-5°50'
-5°40'
-5°30'
-5°20'
-5°10'


Puerto de Santa Maria
C diz
0 1 2 4 6 8 10
Nautical miles
San Fernando (Gallineras)
Conil
SPAIN
Estepona
Barbate
Algeciras
La linea
Océano Atlántico
30m
100m
200m
Tarifa
Mar Mediterráne
500m
Ceuta
Tanger
MAROC
CPUE (kg / N° Lances)
0.0
0.1 - 2.2
2.3 - 4.4
4.5 - 6.1
6.2 - 8.9
36°30'
36°20'
36°10'
36°0'
35°50'
35°40'
35°30'
-6°30'
-6°20'
-6°10'
-6°0'
-5°50'
-5°40'
-5°30'
-5°20'
-5°10'

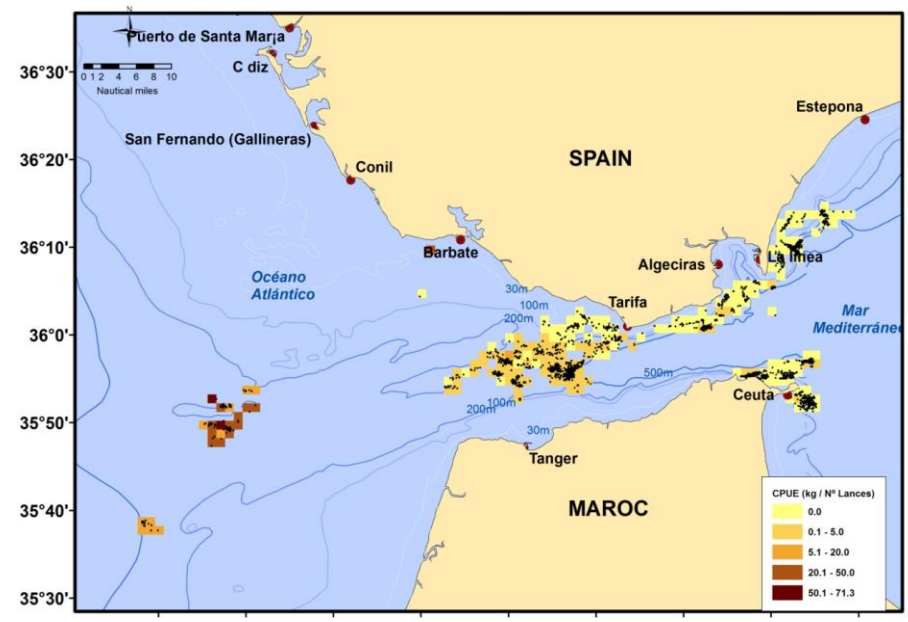


Figure A.2.2. Red seabream Spanish "*voracera*" fishery of the Strait of Gibraltar: spatial distribution of landings from 2014 (top) to 2018 (bottom) (from Gil *et al*., 2016, 2017, 2018 and 2019).

Detailed information from Portuguese fisheries has been provided to the Working Group by Araújo *et al*. (WD to the 2016 WGDEEP, WD to the 2017 WGDEEP), Farias *et al*. (WD to the 2018 WGDEEP) and Farias and Figueiredo (WD to the 2019 WGDEEP). As well as in other Spanish places in Subarea 9, it is admitted that there is no target fishery towards blackspot sea bream in Portugal mainland although the species can be seasonally targeted: the species is usually caught as by-catch of fisheries targeting other species. The majority of deep-water species landings as fresh fish in mainland Portugal correspond to the polyvalent fleet, which uses mainly longlines, while landings from trawlers are the second more relevant. The main landing ports (≈89% of the species mainland Portugal total landings) from North to South are: Matosinhos, Aveiro, Nazaré, Peniche, Sesimbra and Sagres. Among those, higher landings were registered in the southern ones (Peniche, Sagres and Sesimbra), possibly due to a higher abundance of the species in the nearby fishing grounds.

Araújo *et al*. (WD to the WGDEEP 2016, WD to the WGDEEP 2017) presents information of blackspot seabream spatial distribution from Portuguese research surveys. In continental Portugal this species distributes along the coast, but has been preferentially caught in the southern waters. It seems to have a patchy distribution; occurring predominantly in the same areas over the years were the groundfish survey take place, frequently at the Arrifana dept strata from 200 to 500 meters depth (Figure A.2.3).

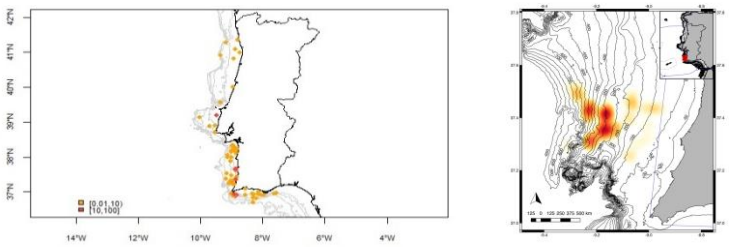


Figure A.2.3. Blackspot seabream in ICES Subarea 9: Species spatial distribution along the Portuguese slope based on the Portuguese Autumn Groundfish Survey (PT-GFS) information between 1990 and 2015 (no survey was conducted in 2012) (left) and density distribution at the Arrifana depth strata (right) (from Araújo *et al.*, WDs to the 2016 and 2017 WGDEEP).

Farias and Figueiredo (WD to the WGDEEP 2019) presents information on blackspot seabream spatial distribution from Portuguese research surveys, considering the relative frequency of fishing hauls with species catch rates higher than 5 specimens in the 1990-2017 surveys. It is concluded that the species is not evenly distributed along the surveyed area, being more frequently caught at specific grounds, suggesting a patchy distribution. In the northern coast of Portugal, the species is caught down to 100 m deep, whereas preferred habitats are between 200 and 400 m deep in the southwestern coast (Figure A.2.4).

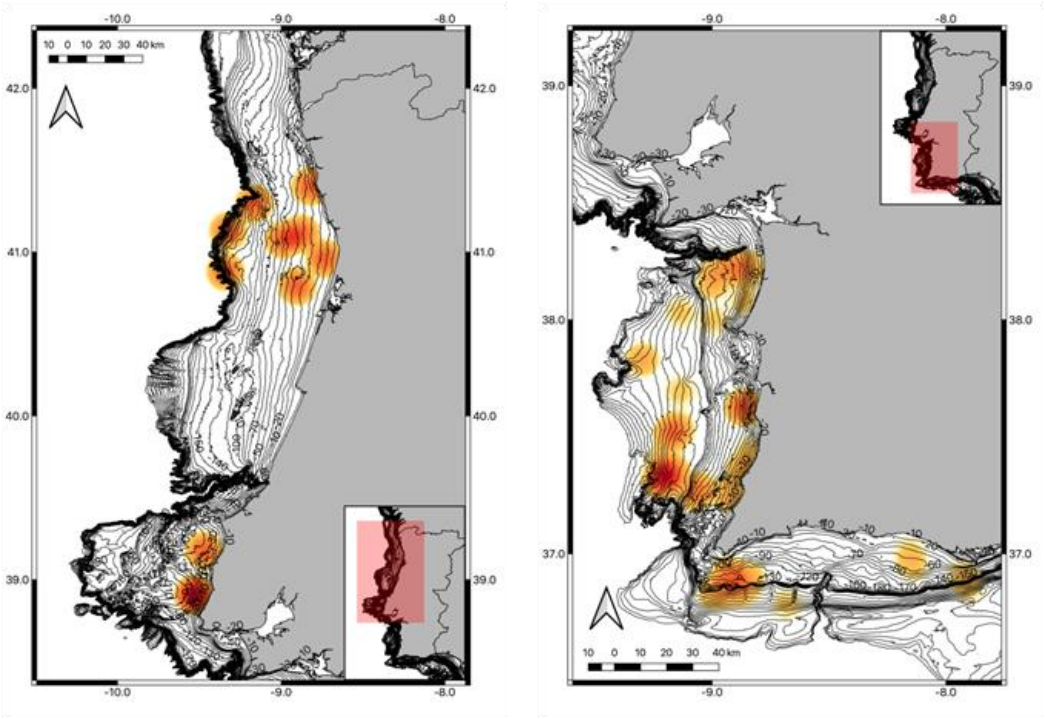


Figure A.2.4. Blackspot seabream in ICES Subarea 9: Distribution of *Pagellus bogaraveo* along the Portuguese coast based on Portuguese surveys from the period between 1997-2011 and 2013-2017. The coloured blotches are hauls with Pagellus bogaraveo catches over 5 n.h-1. The colour intensity of the blotches reflects species occurrence (from Farias and Figueiredo, WD to the 2019 WGDEEP).

A.3. Ecosystem aspects

Blackspot seabream is a bentho-pelagic species that inhabits various types of bottom (rock, sand, and mud) down to a depth of 900 m. It 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).

Feeding habit of this species has been little studied. Morato *et al*. (2001) describes the diet of *Pagellus bogaraveo* and *Pagellus acarne* in the Azores and Olaso and Pereda (1986) describe the diet of 22 demersal fish in the Cantabrian Sea including *Pagellus bogaraveo*. In the Strait of Gibraltar fishery, feeding studies presents the difficult of the use of bait (sardine), which should be ignored to describe the feeding habit of the species. A total of 1106 red sea bream stomachs contents were analysed: 725 stomachs were empty and 381 were fullness. Vacuity index (VI) was 66%. The trophic spectrum is composed of 24 prey taxa, s9 orders, eleven families and 15 species and genera are represented. Despite the trophic spectrum diversity

observed, the overall diet is not very diverse. Blackspot seabream in the Strait of Gibraltar has only a main prey, *Sergia robusta* (J. Gil, *pers.com*.).

The Strait of Gibraltar plays a key role as a route of passage for many migratory marine species as well as as an important foraging area: oceanographic features in this region generate upwelling of nutrient-rich waters and, therefore, a high primary production that can support a diverse food web. In this ecosystem, the blackspot seabream and the Atlantic bluefin tuna occupy high trophic levels.

Main blackspot seabream predators are unknown in the Strait of Gibraltar waters but maybe dolphins' (personal communication from Ceuta veterinary) and Bluefin tuna's (personal communication from fishermen) predation should be taken into account. Studies in Azores (Gomes *et al*., 1998) cite that *Conger conger, Raja clavata* and *Galeorhinus galeus* must be considered as potential predators (all three species are present in Strait of Gibraltar area). Besides, other considerations as the competition for food of blackspot seabream with other big predators in the Strait of Gibraltar (i.e. Bluefin tuna, marine mammals, etc.) and those related with environmental parameters (variation and long-term atmospheric oscillations) might affect the stock status as well as its the fisheries. In fact, the dwindling black spot seabream catches in recent years coincide with the rebound of bluefin tuna biomass in the region, and so the blackspot seabream fishermen blame the scarcity of its catches to the pressure exerted by bluefin tuna on its target species, either directly by predation or indirectly by competition for the same resources.

University of Cadiz (Spain) is running the VORATUN Project (CTM2017-82808-R: Study of blackspot seabream-bluefin tuna interactions in the food web of the Strait of Gibraltar with analysis of stomach contents and stable isotopes: Impact on fisheries) that hopefully will contribute to a better understanding of the possible relationships between both species.

Deep-sea coral ecosystems represent true biodiversity hot spots. OSPAR identified cold-water coral ecosystems as one of the most vulnerable ecosystems where action is required now to mitigate further loss of biodiversity. Figure A.3.1 shows the deep-water coral occurrences in the Strait of Gibraltar.

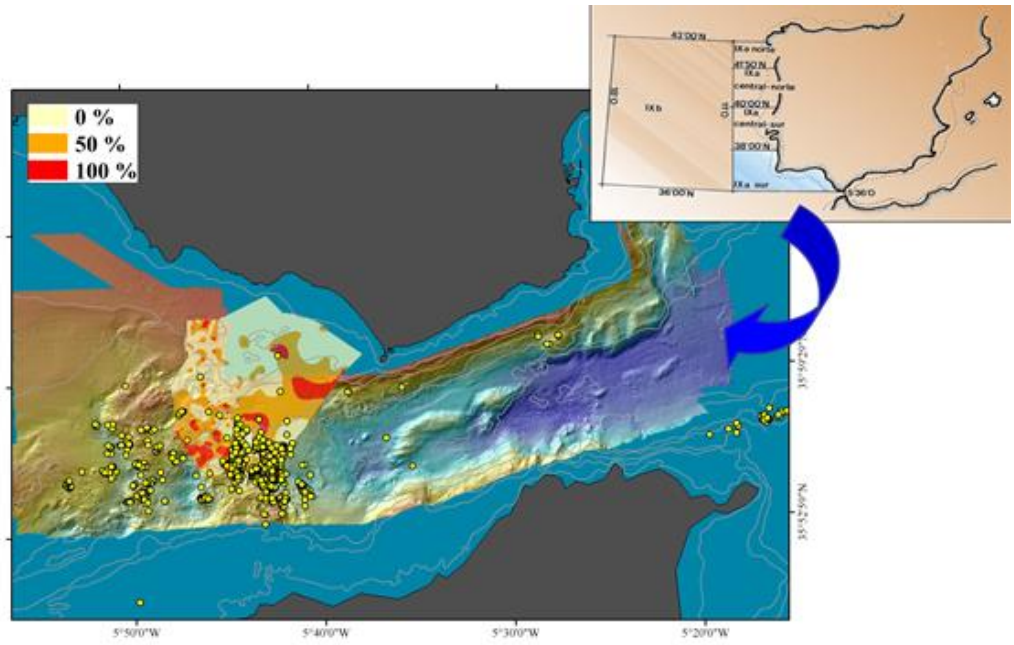


Figure A..3.1. Coral distribution in the Strait of Gibraltar (adapted from Álvarez-Pérez *et al*. in Freiwald and Roberts, Eds. 2005). Yellow points correspond to "*voracera*" fleet fishing grounds from observers on board programme. Legend refers to percentage cover of coral.

B. Data

B.1. Commercial catch

In Subarea 9, catches, most of them taken by lines, correspond to Spain and Portugal. Spanish landings data from this area are available from 1983 and Portuguese from 1988 onwards. The maximum catch in this period was obtained in 1993–1994 and 1997 (about 1000 t). Catches in 2009 amount to 718 t, but decreases again till the minimum (95 t) in 2018.

Almost all Spanish catches in this area are taken in waters close to the Gibraltar Strait. Until 2002 they were restricted to two ports (Tarifa and Algeciras), but from 2002 significant catches were obtained also by artisanal Spanish boats of a third port (Conil) in different fishing grounds of the same area. An increasing trend in landings was observed but since 2008 it only rates an average of 15 t, lower than in the early years.

In the Portuguese landings no clear tendency is observed. The maximum values took place in 1988 (370 t) and in 1998 (357 t) and the minimum one in 2000 (83 t). In 2013 landings was 90t.

Moroccan information shows a continuous increasing trend in landings from 2001 to 2011 but afterwards decreases too.

Without the Moroccan landings, compared to the minimum from 2013 in 2015 landings increased more than the 160% in the whole Subarea 9. In addition Gil *et al*. (WD to the WGDEEP 2016) reported more than the 252 % in the Strait of Gibraltar fishery in 2015 compared to 2013. Again, it should be noted that not every Spanish landings from the Strait of Gibraltar come from ICES Subarea 9.

Last years landings are presented above. Note that Strait of Gibraltar ones (from Spanish fishery) are assigned also to adjacent areas from 2015 onwards.

Year	Portugal	Spain	Morocco*	Unallocated	TOTAL
2010	105	379	107		484 (107*)
2011	74	259	136		333 (136*)
2012	143	60	122	92	295 (122*)
2013	90	91	92		181 (92*)
2014	59	203	118		262 (118*)
2015	66	87 (142**)	219		295 (219*)
2016	70	95 (77**)	159		242 (159*)
2017	69	61 (18**)	188		148 (188*)
2018	58	29 (8**)	72		95 (72*)

***Morocco landings are available from the Subregional Committee on the Western Mediterranean 2019 meeting, which includes a benchmark workshop on blackspot sea bream (GFCM SCR-WM 2019)**

****Figures in brackets includes blackspot seabream from other areas (FAO 34.1.11. and FAO 37.1.1).**

Length frequencies of landings are available for the Spanish blackspot seabream fishery in the Strait of Gibraltar. There was a decrease of the mean size from 1995 to 1998. It is necessary to point out that the red sea bream may have a variable length distribution depending on its geographic and bathymetric distribution, as suggests the different mean length of landings measured in ports (Tarifa and Algeciras). The mean length of the landings increased steadily in both ports from 1999 onwards then decreased but has been increasing again between 2006 and 2009. The mean length from both landing ports declined in 2010. However the median value is lower than the mean since 1995, and very close to the minimum landing size in Algeciras. Only one mean value (in 1998) is lower than the 2013 year´s mean landing size. Median values are well below the mean in recent years. However, changes are small and gradual. There seem to be a long-term decline, despite the mean length ups and downs over the last decade (Figure B.1.1).

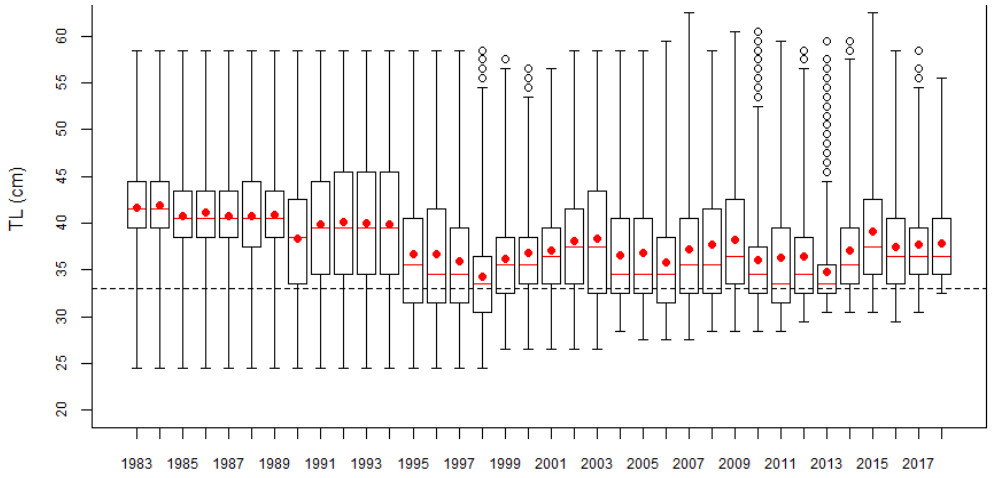


Figure B.1.1. Spanish "*voracera*" Red (blackspot) sea bream fishery of the Strait of Gibraltar: 1983–2018 landings mean length distribution (from Gil *et al.*, WD to the 2019 WGDEEP).

A Kolmogorov-Smirnoff test reflects significant differences ($p<0.05$) between the length distributions from Spain and Morocco (Belcaid *et al.*, WD to the 2011 ICES WGDEEP) and also within Spain (Gil *et al.*, WD to the 2011 ICES WGDEEP). Differences among the sampling protocols may be the explanation to the observed difference. In Moroccan and Spanish observers' programme the sampling covers certain the boats (random sampling) while in the Spanish first sale fish market the sampling covers the four market categories (stratified sampling). So raising the random sampling weight to the total landings did not take into account the difference due to the variability of the length composition related to bathymetric distribution of the species and the stratified sampling seems to be more appropriate.

Commercial fleet data are now available (Araújo *et al.*, WD to the WGDEEP 2017). Figure B.1.2 shows length frequency distribution by gear in Peniche landing port from 2009 to 2016: longlines caught a major proportion of larger fish (30–40 cm) while gillnets and bottom trawl get smaller (25–30 cm).

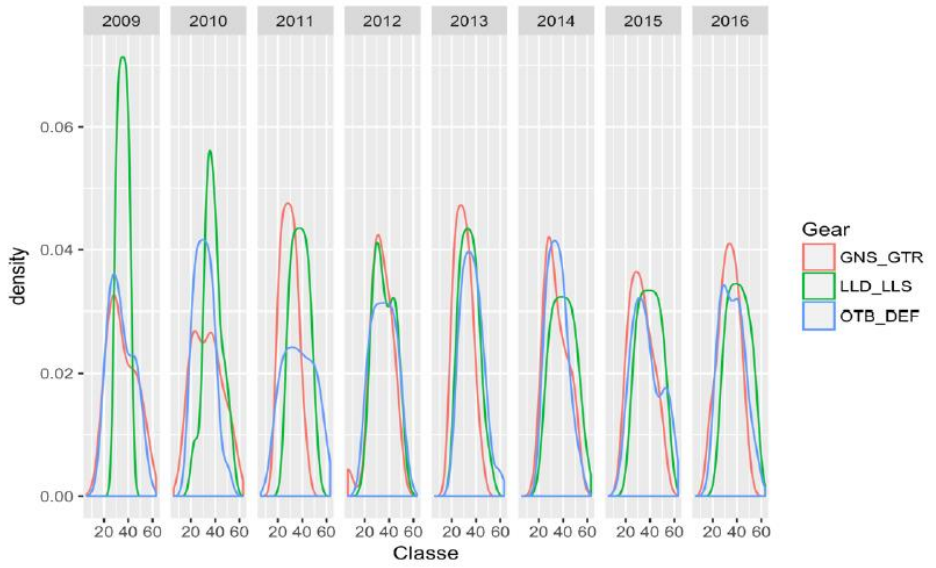


Figure B.1.2. Blackspot sea bream in ICES Subarea 9: length frequency distribution by gear (longlines, gillnets and bottom trawl) in Peniche landing port(from Araújo *et al.*, WD to the 2017 WGDEEP).

Farias and Figueiredo (WD 14 to the WGDEEP 2019) present length the frequency distribution by fishing gear (and its correspondence to commercial size categories) for 2014 – 2016 landings in the port of Peniche (Figure B.1.3).

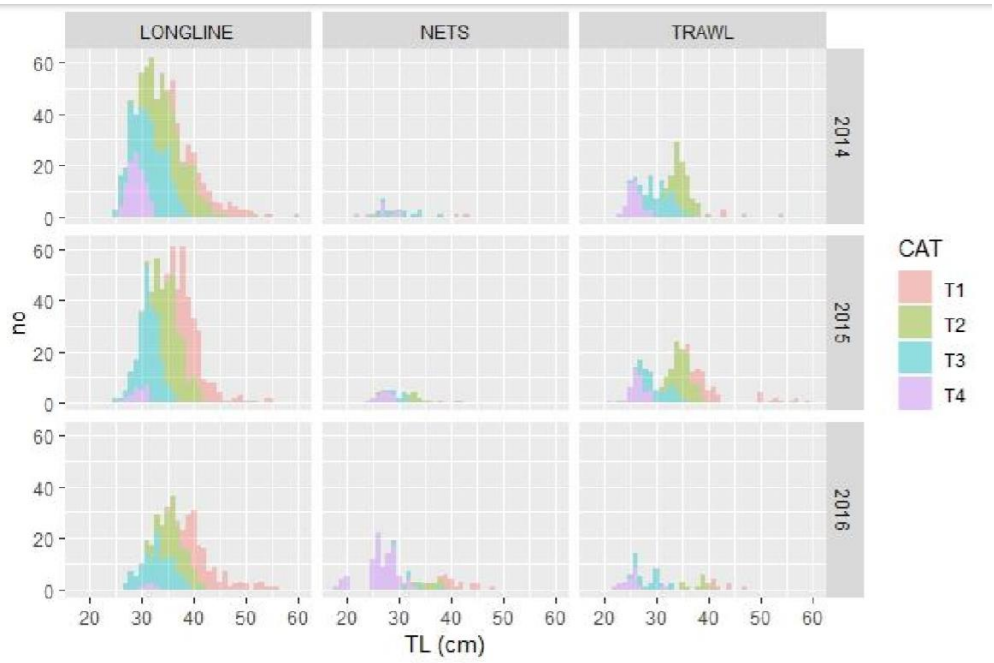


Figure B.1.3. Peniche (Portugal) landing port: Pagellus bogaraveo length frequency distribution by fishing gear and its correspondence to commercial size categories for the year 2014 to 2016 (from Farias and Figueiredo, WD to the 2019 WGDEEP).

Portuguese and Spanish discard information was available to the Working Group from on-board sampling programme (EU DCF/NP). For this species discards can be assumed to be zero or negligible for most assessment purposes and those that do occur are mainly related to catches of small individuals: therefore, for this stock, all catches are assumed to be landed at this moment.

B.2. Biological

Blackspot seabream is a protandric hermaphrodite species changing from males to females. Blackspot seabream have a low productivity and they change sex as they age, starting as males and becoming females between ages 4 and 6. Measures to ensure balanced exploitation between younger fish (males) and older fish (females) are essential.

An annual reproductive cycle has been described for the species in this area (Gil, 2006). The spawning season seems to take place during the first quarter of the year. The smallest specimens are mainly males, maturing at a L_{50}=30.15 cm. At about 32.5 cm in total length, an important percentage of individuals change sex and became females, maturing at L_{50}=35.73 cm. Thus, from age 5 all individuals can be considered mature, whether they are males or females.

Blackspot seabream is a hermaphrodite species. Gil *et al*. (WD to the 2019 WGDEEP) present the percentage of males, females and hermaphrodites from biological samplings Figure B.2.1) as well as an estimation of length at which sex change occurs for several years (Table B.2.1).

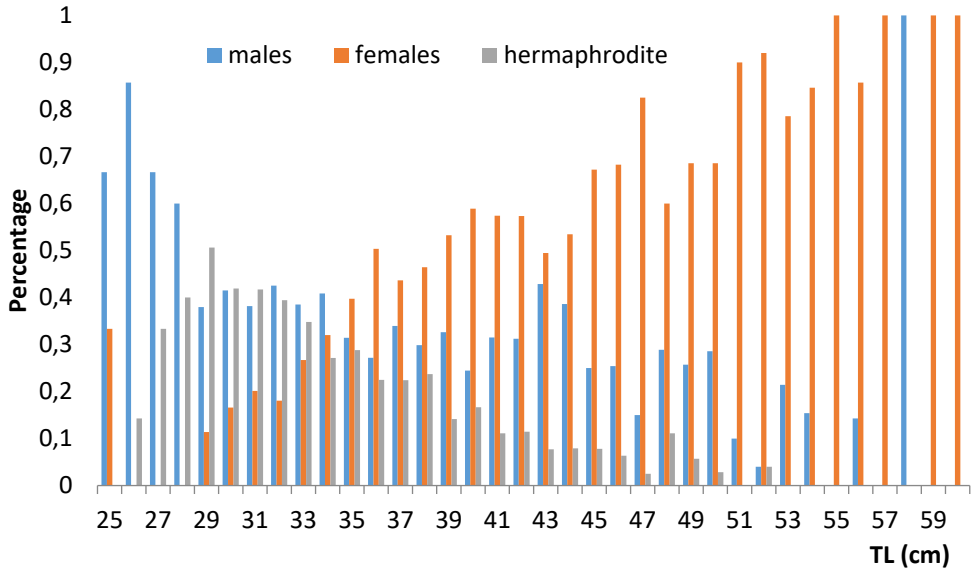


Figure B.2.1. Blackspot seabream Spanish biological samplings from the Strait of Gibraltar target fishery: percentage of males, females and hermaphrodites by Total Length (cm) (from Gil *et al*., WD to the 2019 WGDEEP).

Table B.2.2. Blackspot seabream Spanish biological samplings from the Strait of Gibraltar target fishery: estimation of Total Length (cm) at sex change (adapted from Gil *et al.*, WD to the 2019 WGDEEP).

Year	Number of samples	TL (cm)*	TL (cm)**	% of samples with TL between 29 and 40 cm
2003	391	39.0	36.0	55
2004	930	35.0	33.2	70
2005	310	38.9	34.9	53
2006	678	36.8	34.6	67
2007	584	37.6	34.9	68
2008	509	37.5	34.6	65
2009	325	38.5	35.7	65
2014	285	35.3	34.0	76
2015	238	34.0	33.6	93
		Mean= 36.96	Mean= 34.61	
		SD= 1.82	SD= 0.91	

*** TL at sex change estimated from different length ranges by year**
****TL at sex change estimated from the same length range (290-400 cm) every year**

Blackspot seabream is considered a slow growing species. A combined ALK was obtained by three agreed readings from 1497 otoliths collected from 2003 to 2008 (Gil *et al.*, 2009). It comprises lengths from 24 to 54 cm and ages between 3 and 10, but it has not been validated yet. According to the available information the maximum age recorded in Subarea 9 is ten years. However, the ages of older fish may be underestimated and it is possible that this species may be slower growing and longer-lived than current studies indicate. In fact, there was one recapture from tagging surveys notified more than ten years after its release (J. Gil, *pers. com.*). Table B.2.2 presents different estimates of von Bertalanffy Growth Function (VBGF) parameters available from otoliths readings or tag–recapture data.

Table B.2.2. Blackspot seabream of the Strait of Gibraltar: VBGF parameter estimates.

Authors	Study Area	Methodology	T_0	K	L_∞
Sobrino and Gil, 2001	Strait of Gibraltar	Otholits reading	-0.67	0.169	58.00*
Gil *et al.*, 2008	Strait of Gibraltar	Otholits reading	-1.23	0.169	62.00*
Gil *et al.*, 2009	Strait of Gibraltar	Otholits reading	-0.34	0.162	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (1)		0.079	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (2)		0.098	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (3)		0.161	62.00*
Gil *et al.*, 2008	Strait of Gibraltar	Recaptures (4)		0.080	62.00*

(1)Gulland y Holt, 1959 (2)Munro, 1982 (3)Fabens, 1965 (4)Appeldoorn, 1987.
*** L_∞ (from the largest observed sample).**

Padillo *et al*. (WD to the 2011 WGDEEP) present new information based on Discriminant Analysis of several of the samples used to make the ALK, combining morphometric and morphological variables to re-estimate red sea bream ages. The reclassification success percentage was 85.3%, well above from the 70% adopted by other authors (Palmer *et al*., 2004 and Galley *et al*., 2006). Changes in otolith shape could be related to the growth rate and be also strongly influenced by environmental components. Therefore, future work should include the analysis of such factors throughout years and cohorts.

The natural mortality of *Pagellus bogaraveo* is uncertain because there are no data available to estimate M directly. A mortality rate of 0.2 year^{-1} has been adopted by several authors in several studies from other areas (Silva, 1987; Silva *et al*., 1994; Krug, 1994; Pinho *et al*., 1999; Pinho, 2003) and also by Gil (2006) for the Strait of Gibraltar.

Age and growth based on otolith readings were revised along the ICES WKAMDEEP meeting (October, 2013): No more than ten years of age was estimated from otolith readings in the Strait of Gibraltar area but two recaptures from the tag–recapture programme have remained at sea for more than ten years (J. Gil, *pers. com*.). Moreover, growth estimates from tag–recapture experiments suggest that otolith readings may underestimate age and that some hyaline rings are uncounted and/or missing. The use of biased age estimates may have important consequences.

Age and growth, based on otolith readings, were revised again at the ICES WKAMDEEP2 meeting (September, 2018): A one-page template manual was first discussed and amended by the Group at the start of the meeting. Then this template was filled in for each species based on a demonstration of common practice by an expert reader of that species, followed by discussions in plenary. The finally agreed one-pagers are considered both necessary and sufficient as basis for a generic age reader of deepwater fish to be able to produce reasonably accurate and precise age estimates of each species. However, for this species the reading proved to be difficult, with low percentage of agreement (34.7) between the 12 participating age readers and high Coefficient of Variation (CV = 30.8), which is the consequence of low precision between the readers (i.e. difference of several years among readers for the same otolith). One of the reasons for these results might have been the inclusion of age readers with no or very limited experience. Restricting the comparisons to the two highest ranked readers for each species resulted in a reduction of CV to 15.7, close to the value that ICES (2013) considered more realistic and acceptable.

Serra-Pereira *et al*. (WD to the 2019 WGDEEP) give information about the survivability experiments in Portugal mainland. The observed survival rate of blackspot seabream captured by demersal longline after 6h was 97% and 86% after 36 hours, similar to those obtained for the same species in other areas and fisheries: the estimated survival rate for hooks and lines in the Azores Islands (ICES Subarea 10) was 90.2% (average husbandry of 21 days with an average transport duration of 36 hours) while for the "*voracera*" target fishery in the Strait of Gibraltar (ICES Subarea 9) it was 90.6% after 5 hours.

B.3. Surveys

Only tagging surveys were carried out in the Strait of Gibraltar area. Several tagging surveys (56 days at sea in 2001, 2002, 2004, 2006 and 2008) have been conducted in the Strait of Gibraltar area. 4500 fish were tagged and 404 recaptures have been reported. No significant movements have been observed, although local migrations were noted: feeding grounds are distributed along the entire Strait of Gibraltar and the species seems to remain within this area as a resident population (Gil, 2006). Recaptures of tagged fish have also been reported by the Moroccan fishery.

Figure B.3.1 presents abundance indexes from records in Portuguese research surveys, particularly on the Portuguese crustacean surveys/Nephrops TV Surveys (PT-CTS [UWTV (FU 28–29)]) and the Portuguese Autumn Groundfish Survey (PT-GFS). Catch rate (n/h) is presented for the sector where the species was more regularly sampled (Arrifana, SW Portugal) and for the depth strata with most adequate data in each survey. Results highlight not only its patchy distribution but aggregation pattern: when sampled, the catch rates are relatively high in most cases (Araújo *et al*., WD to the WGDEEP 2016).

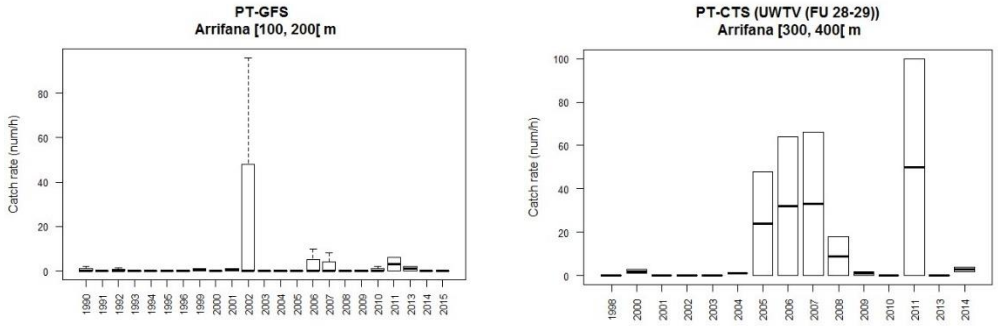


Figure B.3.1. Blackspot seabream in ICES Subarea 9: Catch rate of P. bogaraveo in the "Arrifana" sector SW Portugal), in depth strata with high catch rates from Portuguese Autumn Groundfish Survey (PT-GFS), between 1990 and 2015 (no survey was conducted in 1997, 1998 and 2012; in the remaining years this sector and depth stratum was always sampled) and Portuguese crustacean surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29)) undertaken between 1997 and 2015 (no survey was conducted in 2012; this sector and depth stratum was not sampled in 1997, 1999 and 2015) (from Araújo *et al*., WD to the 2016 WGDEEP).

The availability of Portuguese research surveys data (Araújo et al., WD to the WGDEEP 2016) shows a clear increase of specimens' length with depth. Mean length by depth strata is similar between the two Portuguese surveys (100 to 300 m depth strata). However, overall data suggest that Groundfish survey catches a greater amount of smaller specimens (Figure B.3.2).

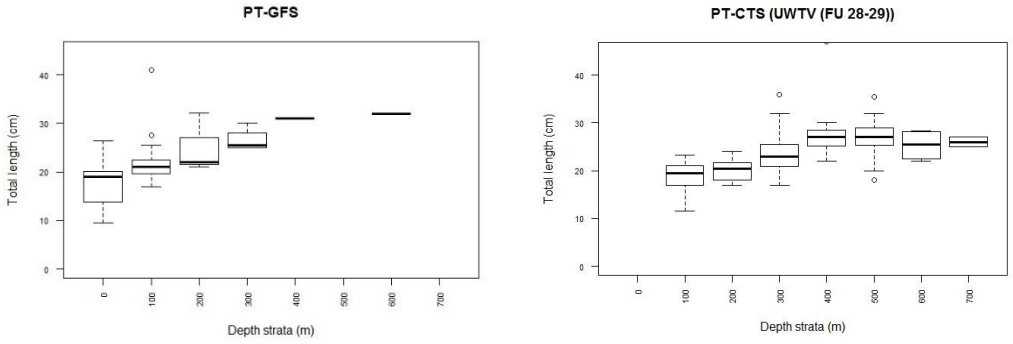


Figure B.3.2. Red (blackspot) seabream in ICES Subarea 9: Boxplot of length distribution of *P. bogaraveo* by depth strata based on the the Portuguese Autumn Groundfish Survey (PT-GFS), between 1990 and 2015 (no survey was conducted in 2012) and the Portuguese crustacean surveys/Nephrops TV Surveys (PT-CTS (UWTV (FU 28-29)) undertaken between 1997 and 2015 (no survey was conducted in 2012) (from Araújo *et al.*, WD to the 2016 WGDEEP).

B.4. Commercial cpue

It should be noted that the effort unit from the historical series, number of sales, may be inappropriate, as it fails to consider the missing effort from boats that have not caught enough fish to go to the market. Thus, in the years this missing effort has increased substantially (fishing vessels with no catches and no sale sheet to be recorded) and its cpue values may be overestimated.

Gil *et al*. (WD 19 to the 2011 WGDEEP) presents a short series of cpue (2005–2009) from the observers' on-board programme in the red sea bream fishery of the Strait of Gibraltar. Sampling level was five boats and three trips per month. Number and length measurements of caught species were recorded. Values vary around three Red sea bream per ±70 hooks but the general trend seems to be slightly decreasing throughout the years.

Burgos *et al*. (2013) demonstrated that a VMS system in operation since 2009 provided a reliable estimate of actual fishing effort and derived a cpue time-series. This cpue series is now used as a biomass index of the stock (see Section C below).

VMS information was updated within the 2019 WGDEEP (Figure B.4.1).

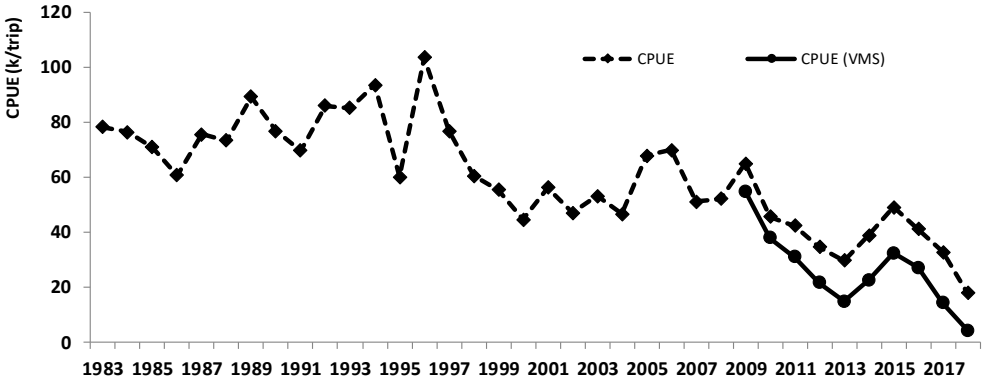


Figure B.4.1. Spanish "*voracera*" Blackspot sea bream fishery of the Strait of Gibraltar (ICES Subarea 9): Estimated lpue using sales sheets (dashed line) and VMS data as unit of effort (continued line) (from Gil et *al*., WD to the 2019 WGDEEP).

Figure B.4.2 presents mean catch rates from the two main gears used at Peniche port: polyvalent and trawl. Results have been quite stable for the polyvalent fleet while the trawler are more variable from 2009 to 2016 (Araújo *et al*., WD to the WGDEEP 2016).

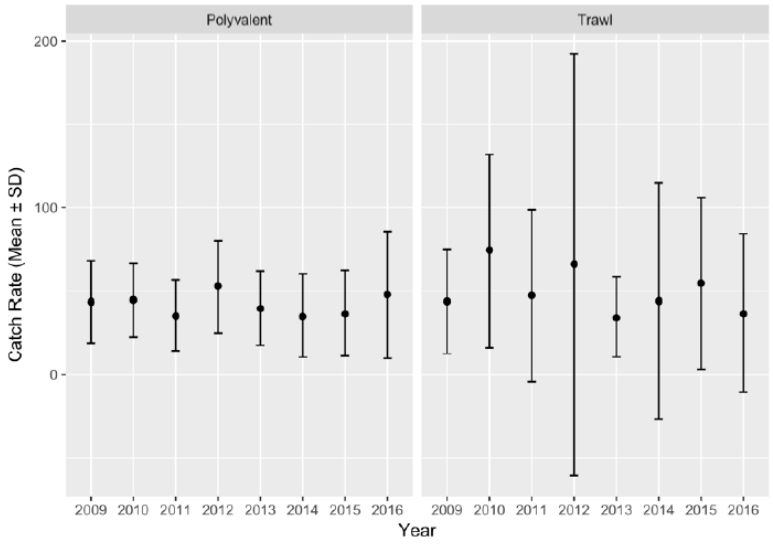


Figure B.4.2. Blackspot seabream in ICES Subarea 9: Mean catch rate of *P. bogaraveo* for the polyvalent and trawl fleets landed in Peniche port, from 2009 to 2016 (from Araújo *et al*., WD to the 2017 WGDEEP).

Figure B.4.3 present mean catch rates from the two main gears, polyvalent (longlines) and trawl, at Peniche port (Portugal coast): standardization procedures to these reference fleets are detailed in Farias *et al*. (WD to the WGDEEP 2018). Catch rates derived from longliners are higher than those from trawl: this probably reflects difference on the species length

range between the two fleets (trawlers mainly catch small size specimens while longlines catch larger ones).

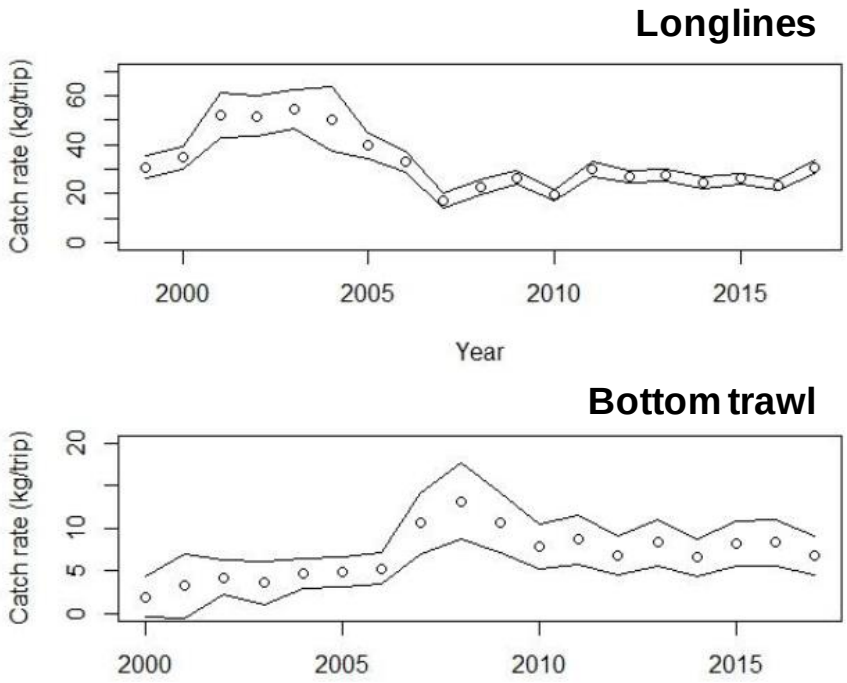


Figure B.4.3. Blackspot sea bream in ICES Subarea 9: catch rate (kg*trip-1) in Peniche port. Above, bottom longline fleet from 1999 to 2017; Below, trawl fleet from 2000 to 2017 (from Farias *et al.*, WD to the 2018 WGDEEP).

Farias and Figueiredo (WD to the WGDEEP 2019) identify two reference fleets landing at Peniche port: a total of 26 fishing vessels (with more than 9 fishing trips per year and more than 6 months with positive landings of the species) were selected for the polyvalent (longliners) while 4 fishing vessels (with more than 9 fishing trips per year and more than 5 months with positive landings of the species) were selected for the trawl fleet. The GLM estimates of the reference fleets' CPUE, considered as landed weight per fishing trip by year, for the selected model are also presented in the WD.

B.5. Other relevant data

Enviromental effects were analyzed from a discrete biomass–abundance dynamic model implemented by Gutiérrez-Estrada *et al*. in 2017 to obtain a simulated monthly time series of blackspot sea bream biomass from the Strait of Gibraltar Spanish target fishery information: the proportion of variance non-explained by the AutoRegressive Integrated Moving Average (ARIMA) fitted models was correlated with a time series of sea surface temperature (SST) and North Atlantic Oscillation (NAO). The analysis of global, annual and winter correlation between the proportion of variance not explained by the ARIMA models and environmental variables showed that significant associations were not detected

over the full time series. So, in the Strait of Gibraltar, overexploitation might be the main factor for the commercial depletion of the blackspot seabream population.

Sanz-Fernández *et al*. (2019) get the same conclusion and suggests that the main factor responsible for the decline in the abundance of blackspot seabream in the Strait of Gibraltar is fishery overexploitation and that environmental conditions (such us water temperature anomaly, salinity anomaly and the NAO index) had a one-off effect which, depending on the year, favoured or harmed the recovery of the stock. In this recent paper they use Spanish and Morocco fishery information (landings and length distributions).

C. Assessment: data and method

Model used: No model was adopted for the assessment yet. Till the moment the assessments attempts were no accepted and only several trends (landings and length distributions) were used for the scientific advice.

So according to the available information, in 2014 DLS method 3.2 (ICES DLS Guidance Report 2012) was selected to estimate C_{y+1} as a reduction of C_{y-1}, applying the 20% Uncertainty Cap and the 20% Precautionary Buffer because the steep declining the catch and in the biomass index occurred over the last years.

Advice basis in 2016 was given according to the DLS 3.2 method again. Thus the quantitative advice increases in 20% (because the biomass index increase, precuautionary cap) from the 2015 and 2016 advice (115 t).

In 2018 the Advice was still given following the DLS 3.2 rule: the inclusion of new catch time series from Morocco in adjacent waters, results in a revision of the start basis for the advice (revision of landings, including those previous to 2014). So, even the decreasing trend of the abundance index used, the advice catches are higher than the advice for 2018: the magnitude of this change in advice was tempered by the decrease in the stock biomass index (-11%).

Software used: None

Model Options chosen: None

Input data types and characteristics:

D. Short-term projection

Model used: None

Software used: None

Initial stock size:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Procedures used for splitting projected catches:

E. Medium-term projections

Model used: None

Software used: None

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock–recruitment model used:

Uncertainty models used:

1) Initial stock size:
2) Natural mortality:
3) Maturity:
4) F and M before spawning:
5) Weight-at-age in the stock:
6) Weight-at-age in the catch:

7) Exploitation pattern:

8) Intermediate year assumptions:

9) Stock–recruitment model used:

F. Long-term projections

Model used: None

Software used: None

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological reference points

	Type	Value	Technical basis
MSY	MSY Btrigger	N/A	
Approach	FMSY	F0.1	YpR Analysis
	Blim	N/At	
Precautionary	Bpa	N/A	
Approach	Flim	N/A	
	Fpa	N/A	

No biological reference points have been defined.

H. Other issues

H.1. Historical overview of previous assessment methods

Historical series of landings data available to the Working Group have been exploratory assessed by the WGDEEP since 2006. No discard data were available to the Working Group, but for this species this could be considered minor. The landings data used in the assessment exercise of red sea bream in 9 included Spanish and Portuguese landings from 1990 onwards.

New assessment exercises were presented to the Group in 2011. An Extended Survivors' Analysis (XSA) attempt with the Strait of Gibraltar Spanish red sea bream fishery data is described by González and Gil (WD to the 2011 WGDEEP). Belcaid *et al*. (WD to the 2011 WGDEEP) presents the results obtained by a Yield-per-recruit analysis from 2005–2007 Spanish and Moroccan landings length distribution available information from the Strait of Gibraltar area.

In 2012, new assessment attempts for the Strait of Gibraltar fishery were presented to the Group by González *et al*. (WD to the 2012 WGDEEP). Simple assessment methods that use historical catches and available trend or size-composition information could potentially be applied to many data-poor stocks. The exercise, which includes two different approaches, appears to be enough indicative because this quite small area comprises more than the 80% from the total of the species in the ICES 9 Subarea:

- Depletion-Corrected Average Catch (DCAC) input parameters were: Sum of Catch along 29 years=12 723, Natural Mortality=0.2 (standard deviation of 0.5 and Lognormal distribution), F_{MSY} to M=0.8 (standard deviation of 0.2 and Lognormal distribution), Depletion Delta=0.47 (standard deviation of 0.3 and Lognormal distribution) and B_{MSY}/B_0=0.4 (standard deviation of 0.1 and Beta distribution). The number of iterations chosen was 10 000.
- Besides, from 2009–2011 available information (Spanish and Moroccan landings and length distributions) Length Cohort (LCA) and Yield-per-recruit (YpR) analysis were carried out. A plus group of 50 cm was established because the anomalous F values in larger length classes. After exploratory analysis using different F terminal random seed values (0.3–0.5–0.8) 0.5 was adopted as F terminal in the final run.

Another join assessment between Spain and Morocco took place in Tangier in November 2014: info update till 2013 and three assessment exercises (LCA, Production model and MSY Catch) using SP+MOR data were attempted (CopeMed II, 2015).

Besides, along the 2012 WGDEEP meeting several exercises were attempted:

- The Catch-MSY method (Martell and Froese) propose a new method for estimating maximum sustainable yield (MSY) from a time-series of catch data, resilience of the species, and estimations about depletion, i.e. relative stock abundances at the beginning and the end of the time-series by means of the Catch-MSY method. With the guidance and help from R. Froese a Catch MSY with the total landings in Subarea 9 was carried out.
- Two new functions within FLR (FLAdvice package) allow us the simulation of a fish stock based on its life-history parameters. From a species complete set of parameters: ages 1 to 17, VBGF growth model (Linf= 62 and k=0.169) and the length–weight relationship (a= 0.014 and b=3.014) the functions derive in a set of biological reference points, including $F_{0.1}$ and $F_{30\%SPR}$.
- Another approach was considered along the WG to estimate BRPs using the Beverton–Holt function developed in R by Azevedo and Cadima (BHAC). As

same as the previous, a set of life-history parameters and derives in an F vector (which includes F_{MAX}, $F_{0.1}$ and $F_{30\%SPR}$ for example).

And also several Biological Reference Points estimates from different approaches were available. Table below summarizes the methods adopted and its estimates:

METHOD/ESTIMATE	FMAX	F0.1	F30%SPR	F40%SPR	FSQ
Gislason spreadsheet (WKLIFE) with AFC=3	0.61	0.26	0.36	0.24	-
Gislason spreadsheet (WKLIFE) with AFC=4	0.77	0.29	0.62	0.37	-
BHAC (WKLIFE)	0.39	0.17	0.20	0.14	-
FLAdvice (WKLIFE)		0.16	0.16		-
YpR Analysis (from LCA outputs)(1)	0.30	0.11		0.12	0.19

(1)Landings from the Strait of Gibraltar only.

WKLIFE Gislason spreadsheet was applied using an L_{MAX} of 62 cm and AFC = 3 and 4. The parameters estimated by the mode were unrealistic based on what is known about this stock and the F_{MAX} value was substantially higher than that estimated by YPR. This may be because the underpinning empirical relationships may not apply to a protandric hermaphrodite species.

In the 2014 meeting no analytical assessment was attempted. Results from gadget exploratory analysis that was presented should be considered preliminary as the model needs a better parameterization. However it was decided the use of the cpue as a biomass index rather than the use of recent landings (like two years before). Thus, the quantitative advice was given according to the DLS 3.2 method instead of the 6.2 that appears in the ICES DLS Guidance Report 2012.

In summary, recent trends are fairly clear; despite Moroccan landings from the Strait of Gibraltar are not available in the years 2012 and 2013. It is however assumed that these landings follow a decreasing trend. Landings have declined significantly over the last four years and may be considered as a substantial reduction in exploitable biomass. Mean length distribution and lpue decreasing trends may also be consistent with overexploited population signals. However, since 2014 all signals (landings, lpue and length distribution) reverted to increase but without any evidence of its sustainability.

In 2016 and 2017, an exploratory assessment (gadget model) was presented to the Group. Model definition and the estimated parameters are conditioned by the available information. It should be remarked that this preliminary model was developed only with the Spanish target fishery information ("*voracera*" fleet). So, the effect of the inclusion of Morocco data from the Strait of Gibraltar area is unknown but it is desirable its future incorporation to the model. More detailed information is available at the WD presented by Gil *et al*. to the 2016 WGDEEP.

In 2017, SPiCT model was attemped within the WGDEEP 2017. Figures H.1 and H.2 presents the preliminary results of the . Surprisely, the model does not have problems fitting the data inputs: blackspot sebream landings (1983-2016) and CPUE from VMS (2009-2016).

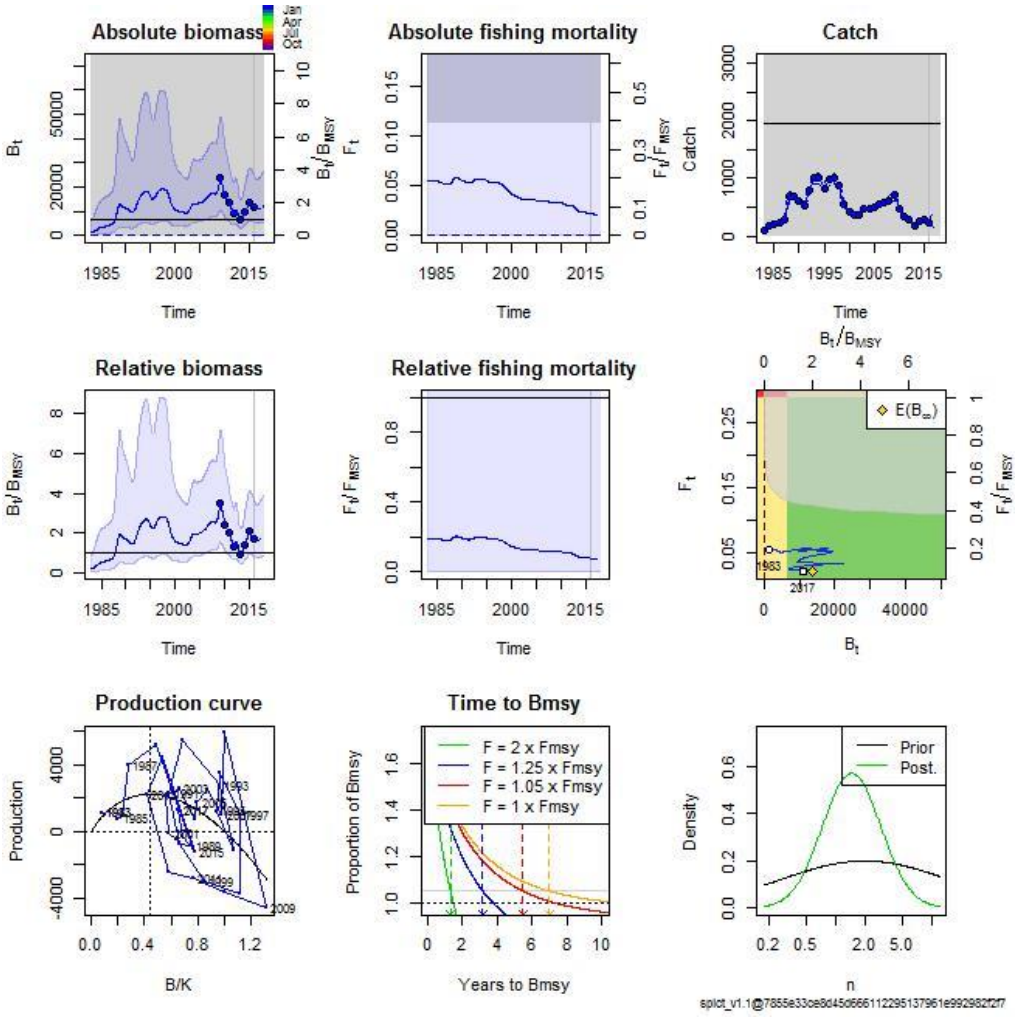


Figure H.1. Blackspot sea bream in ICES Subarea 9: SpiCT summary results.

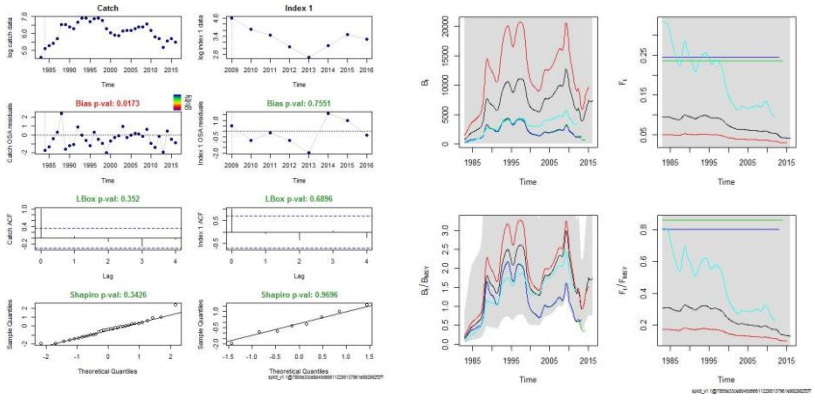


Figure H.2. Blackspot sea bream in ICES Subarea 9: SpiCT diagnostics.

However, the WG considers that the estimates (with wide confidence intervals) are not in conformity with the current perception of the stock status. Further work should be done for the application of MSY proxy reference points (based on SPiCT and/or Length Based Indicators) in order to produce relevant results.

Figures H.3 and H.4 presents the preliminary results of the SPiCT model attempted within the 2018 WGDEEP. The model do not converge when blackspot sea bream total (including Morocco) landings (1983–2017) and cpue from VMS (2009–2017) were used as data inputs (Figure H.3). Another run using two CPUEs (nominal and VMS) from the Spanish target fishery in the Strait of Gibraltar as abundance indices reach the convergence. However, the WG considers that the estimates (with wide confidence intervals) are not in conformity with the current perception of the stock status.

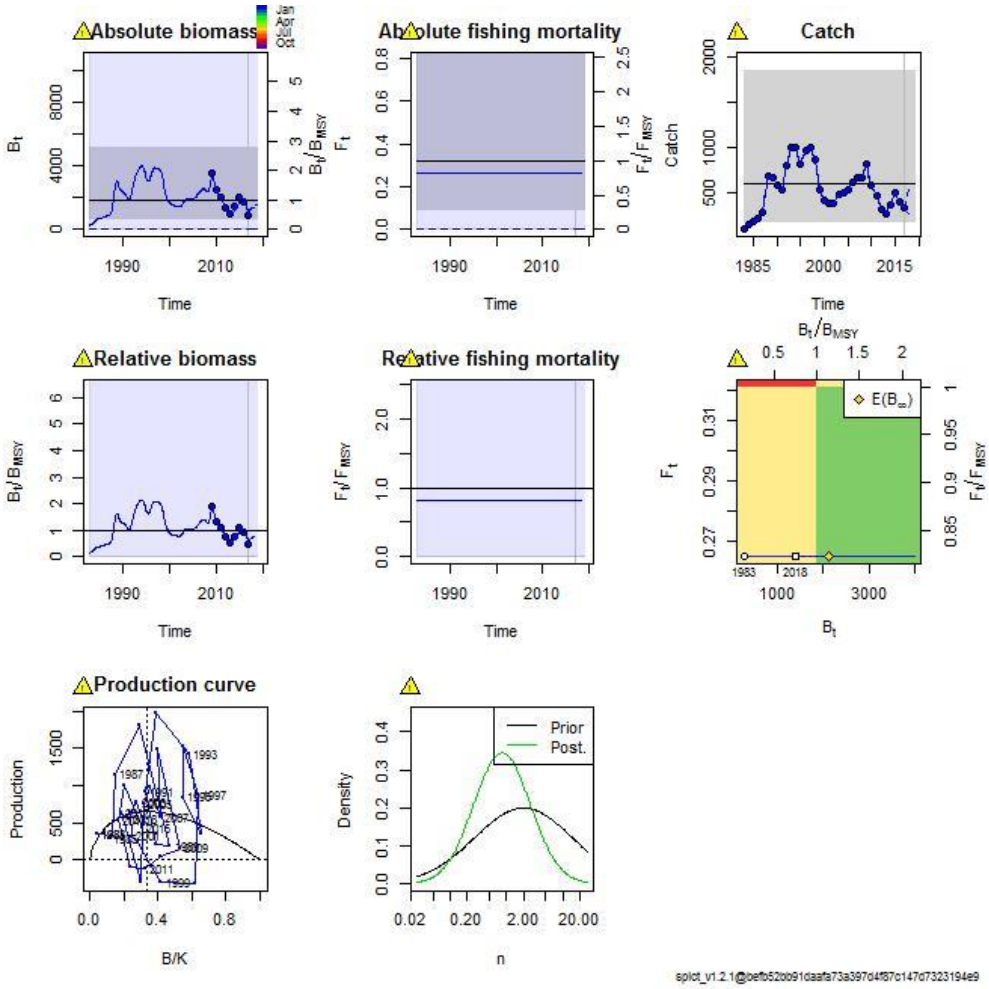


Figure H.3. Blackspot seabream in ICES Subarea 9: SpiCT summary results (only VMS index).

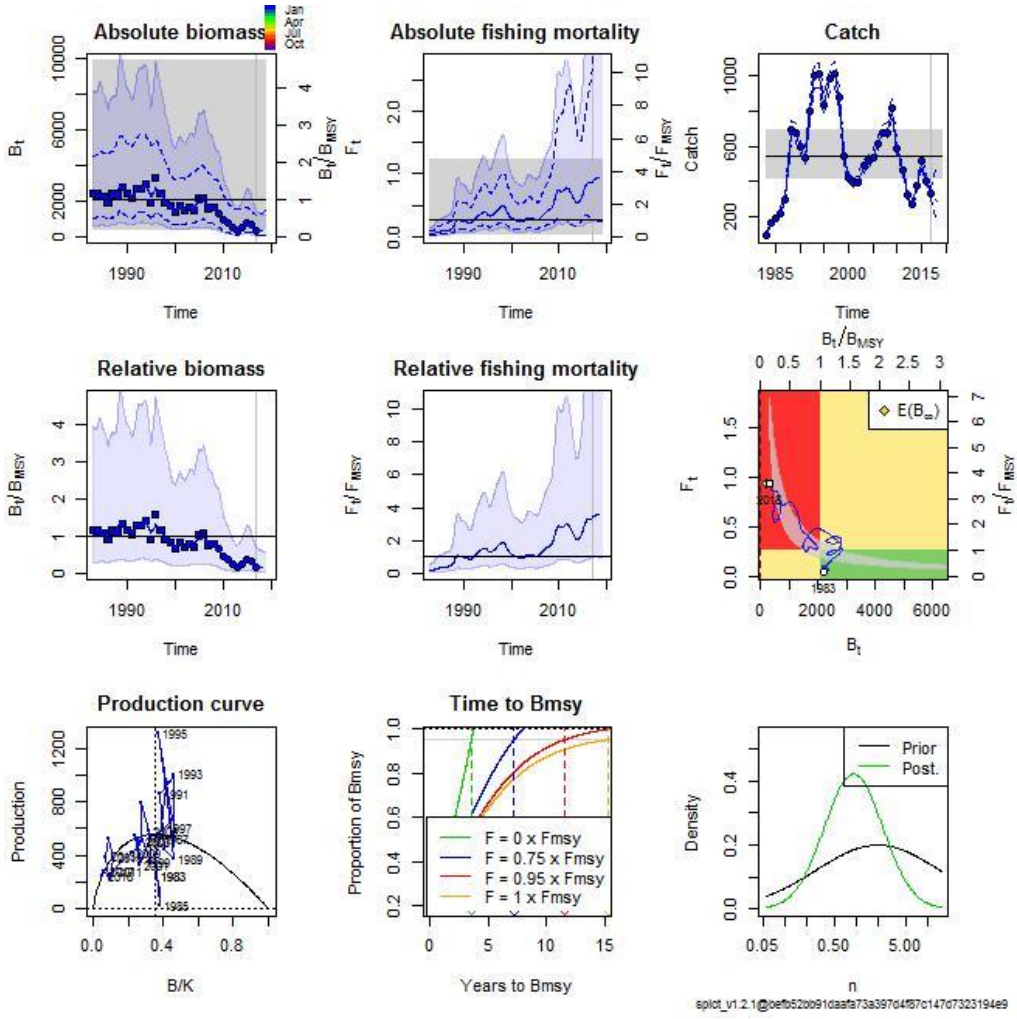


Figure H.4. Blackspot sea bream in ICES Subarea 9: SpiCT summary results (nominal and VMS indices)

The length data used in the LBI model come from the Spanish target fishery of the Strait of Gibraltar. 33 cm are used as an input for L at maturity (taking into account that is a hermaphrodite species and 33 cm is the estimated length at sex, male to females, change) while 62 cm (largest observed sample) was the value for L infinite. Length distribution data (1 cm bin) are raised to total landings from the target "*voracera*" fleet.

Output from the screening of length indicator ratios for combined sexes was con-ducted under three scenarios: (a) Conservation; (b) Optimal yield, and (c) maximum sustainable yield (Figure H.5). Conclusion: Overall perception of the stock during the period 1997–2017 is presented in the traffic lights (Table H.1). However, values are nearby the reference indicator ratios and sensitivity to Lmat and Linf estimates was not explored, so the WG considered it quite prelaminar. Further work should be done for the application of MSY proxy reference points in order to produce relevant results.

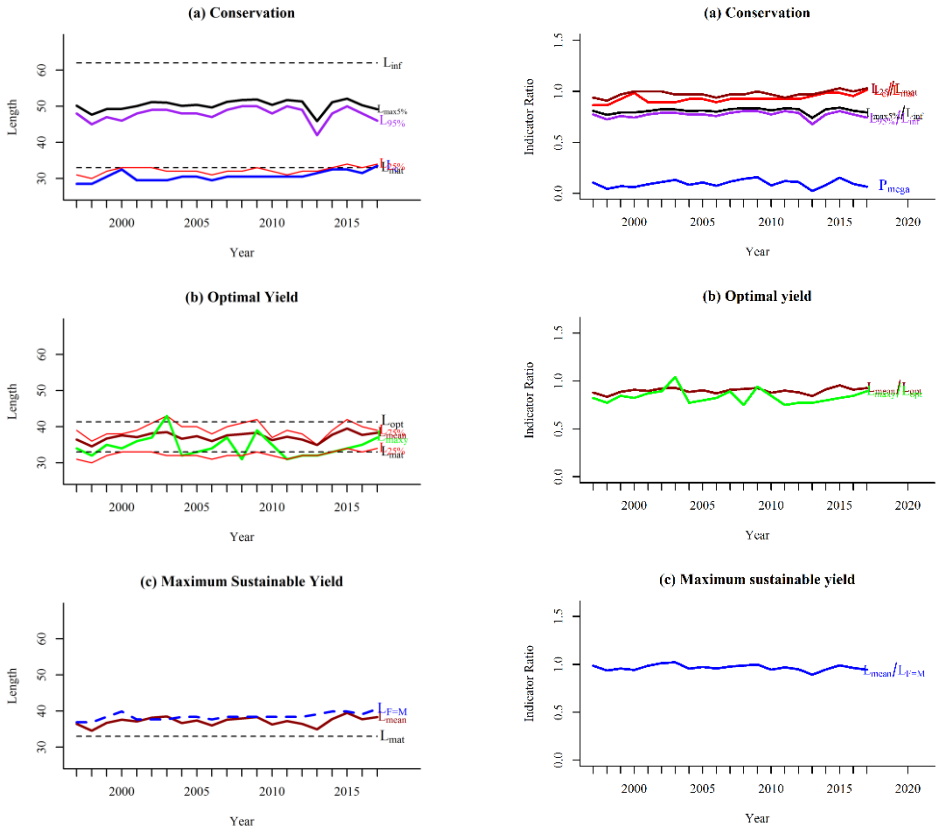


Figure H.5. Blackspot seabream in ICES Subarea 9: LBI outputs.

Table H.1. Blackspot seabream in ICES Subarea 9: LBI traffic lights output.

		CONSERVATION				OPT. YIELD	MSY
		Lc/Lmat	L25%/Lmat	Lmax5%/Linf	Pmega	Lmean/Lopt	Lmean/$L_{F=M}$
Year	Stock/Sex	>1	>1	>0.8	>30%	~1 (>0.9)	?1
1997	sbr9/N	0.86	0.94	0.81	0.11	0.88	0.99
1998	sbr9/N	0.86	0.91	0.77	0.04	0.84	0.94
1999	sbr9/N	0.92	0.97	0.79	0.07	0.89	0.96
2000	sbr9/N	0.98	1.00	0.79	0.06	0.91	0.94
2001	sbr9/N	0.89	1.00	0.81	0.09	0.90	0.99
2002	sbr9/N	0.89	1.00	0.83	0.11	0.92	1.01
2003	sbr9/N	0.89	0.97	0.82	0.13	0.93	1.02
2004	sbr9/N	0.92	0.97	0.81	0.08	0.89	0.96
2005	sbr9/N	0.92	0.97	0.81	0.11	0.90	0.97
2006	sbr9/N	0.89	0.94	0.80	0.07	0.87	0.96
2007	sbr9/N	0.92	0.97	0.83	0.11	0.91	0.98
2008	sbr9/N	0.92	0.97	0.83	0.14	0.92	0.99
2009	sbr9/N	0.92	1.00	0.84	0.16	0.93	1.00
2010	sbr9/N	0.92	0.97	0.81	0.08	0.88	0.95
2011	sbr9/N	0.92	0.94	0.83	0.12	0.90	0.97
2012	sbr9/N	0.92	0.97	0.83	0.11	0.88	0.95
2013	sbr9/N	0.95	0.97	0.74	0.02	0.84	0.89
2014	sbr9/N	0.98	1.00	0.82	0.08	0.91	0.95
2015	sbr9/N	0.98	1.03	0.84	0.15	0.96	0.99
2016	sbr9/N	0.95	1.00	0.81	0.09	0.91	0.96
2017	sbr9/N	1.02	1.03	0.79	0.06	0.93	0.94

Gil *et al*. (WD to the 2018 WGDEEP) summarizes the assessment trials on the target fishery of the blackspot seabream in the Strait of Gibraltar area presented to the GFCM 2018 WGSAD: these include several joint assessments (Spain and Morocco data) but the gadget model was only accepted in terms of "qualitative advice" within the WGSAD. Input data and main results are described in the Working Document. Anyway, fishery sustainability could be compromise at current levels because $F_{CURRENT}$ seems to be about 0.3 in both analytical approaches (LCA/VPA and gadget), far above from the reference point $F_{0.1}$ estimated value (0.14 and 0.17, in YpR respectively models). Figures H.6 and H.7 presents the comparison of biomass and F estimates from these two approaches.

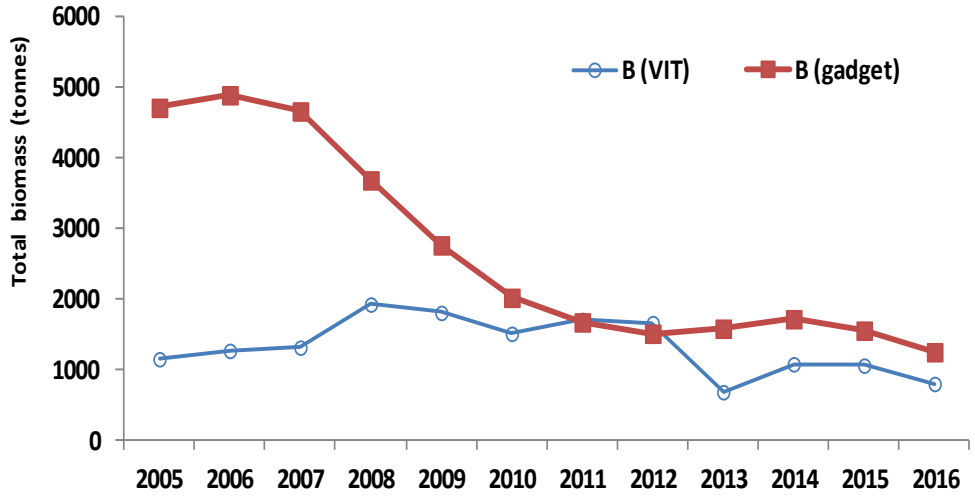


Figure H.6. Blackspot seabream in ICES Subarea 9: comparison between biomass estimates from LCA/VPA (VIT software) and gadget assessment trials for the Strait of Gibraltar target fishery (from Gil *et al.*, WD to the 2018 WGDEEP).

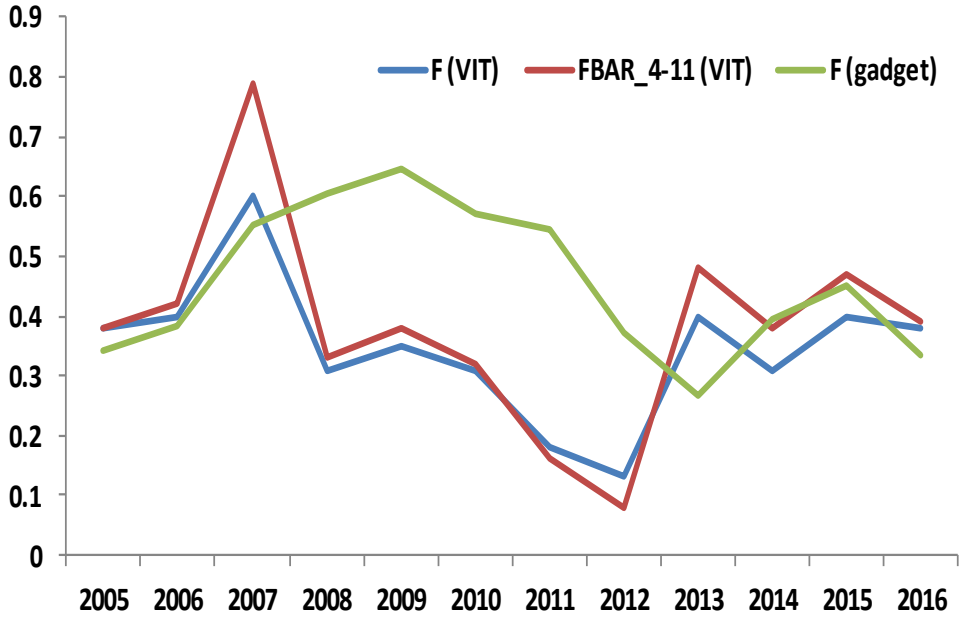


Figure H.7. Blackspot seabream in ICES Subarea 9: comparison between F estimates from LCA/VPA (VIT software) and gadget assessment trials for the Strait of Gibraltar target fishery (from Gil *et al.*, WD to the 2018 WGDEEP).

No exploratory assessments were attemped within the 2019 WGDEEP meeting.

I. References

Alvarez-Pérez, G., P. Busquets, B. de Mol, N. G. Sandoval, M. Canals and J.L. Casamor. 2005. Deep-water coral occurrences in the Strait of Gibraltar. In Cold-Water corals and ecosystems. Freiwald A. and J. M. Roberts (eds.). Springer-Verlag Berlin Heidelberg: 207–221.

Araújo, G:, T. Moura and I. Figueiredo. 2016. Notes on *Pagellus* bogaraveo in the Portuguese continental waters (ICES Division 9.a). Working Document to the 2016 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Araújo, G:, T. Moura and I. Figueiredo. 2017. New data on *Pagellus bogaraveo* in the Portuguese continental waters (ICES division IXa). Working Document to the 2017 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Belcaid, S., J. Gil, J.L. Pérez, O. Kada, J. Baro and A. García. 2011. Summary results about the Red seabream fishery of the Strait of Gibraltar joint assessment exercise between Spain and Morocco. Working Document to the 2011 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Burgos, C., J. Gil and L.A. del Olmo. 2013. The Spanish blackspot sea bream (*Pagellus bogaraveo*) fishery in the Strait of Gibraltar: Spatial distribution and fishing effort derived from a small-scale GPRS/GSM based fisheries vessel monitoring system. Aquatic Living Resources, 26: 399–407.

CopeMed II. 2015. Report of the third meeting of the CopeMed II Working Group between Spain and Morocco on Blackspot seabream (*Pagellus bogaraveo*) of the Strait of Gibraltar area. CopeMed II Technical Documents Nº37 (GCP/INT/028/SPA – GCP/INT/006/EC). Málaga, 2015. 35pp

Desbrosses, P. 1938. La dorade commune (*Pagellus centrodontus*) et sa pêche. Rev. Trav. Off. Pêches Marit., 5 (2): 167–222.

Farias, I., G. Araújo, T. Moura and I. Figueiredo. 2018. Notes on *Pagellus bogaraveo* in the Portuguese continental waters (ICES Division 9.a). Working Document to the 2018 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Farias, I. and I. Figueiredo. 2019. *Pagellus bogaraveo* in Portuguese continental waters (ICES Division 27.9.a) Working Document to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Galley, E., P. Wright and F. Gibb. 2006. Combined methods of otolith shape analysis improve identification of spawning areas of Atlantic cod. ICES Journal of Marine Science, 63: 1710–1717 pp.

GFCM. 2019. Report of the Third meeting of the Subregional Committee for the Western Mediterranean. SAC/SRC-WM.

Gil, J. 2006. Biología y pesca del voraz [*Pagellus bogaraveo* (Brünnich, 1768)] en el Estrecho de Gibraltar. Tesis Doctoral, Universidad de Cádiz (UCA, Spain).

Gil, J, J.J. Acosta, C. Farias and M.M. Soriano. 2012. Updating the information about the Red seabream (*Pagellus bogaraveo*) Spanish fishery in the Strait of Gibraltar (ICES Subarea 9). Working Document to the 2012 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., J.J. Acosta, M.M. Soriano, C. Farias and C. Burgos. 2011. The Red seabream (*Pagellus bogaraveo*) fishery in the Strait of Gibraltar: ICES Subarea 9 updated data. Working Document to the 2011 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., S. Benchoucha, J. L. Pérez, S. el Arraf and B.T. Elvarsson. 2018 Summary of assessment trials on the Blackspot seabream fishery of the Strait of Gibraltar. Working Document to the 2018 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Burgos, C. Farias, J. J. Acosta and M. Soriano. 2017. The Spanish Red seabream fishery of the Strait of Gibraltar: an update of the available information. Working Document to the 2017 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Burgos, C. Farias, J. J. Acosta and M. Soriano. 2018 The Blackspot seabream Spanish target fishery of the Strait of Gibraltar: an update of the available information. Working Document to the 2018 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., J. Canoura, C. Burgos and C. Farias. 2005. Update of the Red seabream (*Pagellus bogaraveo*) fishery data in the Strait of Gibraltar (ICES 9a south) including biological information. Working Document to the 2005 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., J. Canoura, C. Burgos and C. Farias. 2010. The Red seabream (*Pagellus bogaraveo*) Spanish fishery in the Strait of Gibraltar: Useful information that should be considered for the ICES Subarea 9 assessment update exercise. Working Document to the 2010 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., J. Canoura, C. Burgos, C. Farias and V. Polonio. 2008. Red seabream (*Pagellus bogaraveo*) assessment of the ICES 9 from the information available of the fishery in the Gibraltar Strait. Working Document to the 2008 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., J. Canoura, C. burgos and I. Sobrino. 2007. Red seabream (*Pagellus bogaraveo*) fishery of the Strait of Gibraltar (ICES 9a south): Update of the available information. Working Document to the 2007 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., S. Cerviño and B.T. Elvarsson. 2016. A preliminary gadget model to assess the Spanish Red seabream fishery of the Strait of Gibraltar. Working Document to the 2016 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Farias, J. Canoura and J.J. Acosta. 2013. The Red seabream fishery in the Strait of Gibraltar: update of the available information from the fishery statistics and some considerations about the current knowledge on the target species growth. Working Document to the 2013 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Farias, J. Canoura, J.J. Acosta, M. Soriano and C. Burgos. 2015. Updating the available information from Spanish Red seabream fishery in the Strait of Gibraltar. Working Document to the 2015 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Farias, C. Burgos, J. J. Acosta and M. Soriano. 2016. Updating the available information from Spanish Red seabream fishery in the Strait of Gibraltar. Working Document to the 2016 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., C. Farias, C. Burgos, J.J. Acosta and J. Canoura. 2014. The red seabream fishery in the Strait of Gibraltar: an update of the available information. Working Document to the 2014 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., L. Rueda, C. Burgos, C. Farias, J.C. Arronte, J.J. Acosta and M. Soriano. 2019. The Blackspot seabream Spanish target fishery of the Strait of Gibraltar: updating the available information.

Working Document 10 to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., I. Sobrino and M. P. Jiménez. 2000. A brief description of the Strait of Gibraltar red seabream (*Pagellus bogaraveo*) fishery. Working Document to the 2000 Report of the ICES Study Group on the Biology and Assessmnet of Deep-sea Fisheries Resources (SGDEEP).

Gil, J. and I. Sobrino. 2001. New biological information about the red seabream (*Pagellus bogaraveo*) of the Strait of Gibraltar (ICES 9a). Working Document to the 2001 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J. and I. Sobrino. 2002. Update of the information about the red seabream (*Pagellus bogaraveo*) from the Strait of Gibraltar (ICES 9a south). Working Document to the 2002 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J. and I. Sobrino. 2004. Red seabream (*Pagellus bogaraveo*) fishery of the Strait of Gibraltar (ICES 9a south): Update of the information available. Working Document to the 2004 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gil, J., I. Sobrino and J. Canoura. 2003. Update of the information about the red seabream (*Pagellus bogaraveo*) fishery in the Strait of Gibraltar (ICES 9a south). Working Document to the 2003 Report of the ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Gomes, T.M., E. Sola, M.P. Grós, G. Menezes and M.R. Pinho. 1998. Trophic relationships and feeding habits of demersal fishes from the Azores: importance to multispecies assessment. ICES C.M. 1998/O: 7.

González, F. and J. Gil. 2011. Summary results from the XSA exercise attempted with the Red seabream available data from the Spanish fishery in the Strait of Gibraltar. Working Document to the 2011 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Gueguen, J. 1974. Précisions sur le migrations de la dorade rosse *Pagellus bogaraveo* (Brünnich, 1768). Science et Pêche. Bull. Inst. Pêches Marit., 237: 1–9.

Gutiérrez-Estrada, J. C., J. Gil-Herrera, I. Pulido-Calvo and I.A. Czerwinski. 2017. Is it possible to differentiate between environmental and fishery effects on abundance-biomass variation? A case study of blackspot seabream (Pagellus bogaraveo) in the Strait of Gibraltar. Fisheries Oceanography, doi:10.1111/fog.12208.

Hareide NR and G. Garnes. 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 2007/ACFM: 28.

ICES. 2013. Workshop on Age Estimation Methods of Deep-water Species (WKAMDEEP), 21–25 October 2018, Mallorca Island, Spain. ICES CM 2013/ACOM: 83. 85 pp.

ICES. 2018. Workshop on Age Estimation Methods of Deep-water Species (WKAMDEEP 2), 17–21 September 2018, Cadiz, Spain. ICES CM 2018/EOSG: 27. 30 pp.

Morato, T., E. Solá, M. Pitta Grós and G. Menezes. 2001. Feeding habits of two congener species of seabreams, *Pagellus bogaraveo* and *Pagellus acarne*, off the Azores (Northeastern Atlantic) during spring of 1996 and 1997. Bulletin of marine science 69 (3): 1073–1084.

Olaso, I. and P. Pereda. 1986. First results of the studies about the feeding of the species of fishes accompanying the southern stock of hake. International Council for the Exploration of the Sea, C.M. 1986/G:34.

Padillo, M.M., J. Gil and A.M. Juárez. 2011. Morphometric and morphological studies of Red seabream (*Pagellus bogaraveo*) otoliths from the Strait of Gibraltar: Exploratory analysis of its application for ageing. Working Document to the 2011 Report of the ICES Working Group on the Biology and Assessement of Deep-Sea Fisheries Resources (WGDEEP).

Palmer, M., G. Pons and M. Linde. 2004. Discriminating between geographical groups of a Mediterranean commercial clam (*Chamelea gallina* (L.): Veneridae) by shape analysis. Fisheries research 67: 93–98 pp.

Pinho, M. R.. 2003. Abundance estimation and management of Azorean demersal species. Tesis Doctoral. Universidad de Azores. 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., G. Menezes and H. Krug. 1999. Estado de exploração dos recursos demersais dos Açores – Proposta de gestão. Relatório apresentado ao Workshop:"Gestão de Pescas", Secretaria Regional de Agricultura Pescas e Ambiente, Direcção Regional das Pescas. Horta 20 de Março de 1999.Piñera, J., G. Blanco, E. Vázquez and J. Sánchez. 2007. Genetic diversity of blackspot seabream (*Pagellus bogaraveo*) populations off Spanish Coast: a preliminary study. Marine Biology 151(6): 2153–2158.

Piñera, J., G. Blanco, E. Vázquez and J. Sánchez. 2007. Genetic diversity of blackspot seabream (*Pagellus bogaraveo*) populations off Spanish Coast: a preliminary study. Marine Biology 151(6): 2153–2158.

Sanz-Fernández, V., J.C. Gutiérrez-Estrada, I. Pulido-Calvo, J. Gil-Herrera, S. Benchoucha, S. el Arraf. 2019. Environment or catches? Assessment of the decline in blackspot seabream (Pagellus bogaraveo) abundance in the Strait of Gibraltar. Journal of Marine Systems, 190: 15-24 (https://doi.org/10.1016/j.jmarsys.2018.08.005).

Serra-Pereira, B., P. Tomé, T. Bento, I. Farias and I. Figueiredo. 2019. Blackspot seabream (*Pagellus bogaraveo*) in Portugal mainland (ICES Division 27.9.a): fisheries characterization and survivability experiments. Working Document 11 to the 2019 ICES Working Group on the Biology and Assessment of Deep-Sea Fisheries Resources (WGDEEP).

Silva, H. M. 1987. Estado dos stocks de goraz e abrótea. In Relatório da VII Semana das Pescas dos Açores, pp.197–199. Ed. by Secretaria Regional de Agricultura e Pescas, Direcção Regional das Pescas dos Açores, Horta, Açores. 269 pp.

Silva, H. M., H. Krug and G. Menezes. 1994. Bases para a regulamentação da pesca de demersais nos Açores. Arquivos do DOP-Série Estudos, 94. 99 pp.

Krug, H. M. 1990. The Azorean blackspot seabream, *Pagellus bogaraveo* (Brünnich 1768) (Teleostei: Sparidae): Reproductive cycle, hermaphrodism, maturity and fecundity. Cybium, 14, 151–159.