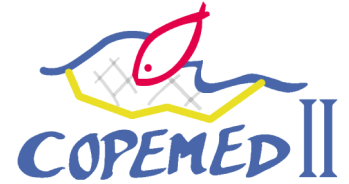




FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS



OCCASIONAL PAPER

2

**SPANISH INFORMATION ABOUT THE RED
SEABREAM (*PAGELLUS BOGARAVEO*) FISHERY
IN THE STRAIT OF GIBRALTAR REGION**

A CopeMed II contribution to:

SRWG on shared demersal resources.

Ad hoc scientific working group between Morocco and Spain on

***Pagellus bogaraveo* in the Gibraltar Strait area**

Málaga, Spain. 22 July, 2010

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Background

Since the early 1980's a mechanized handline fishery targeted to the red seabream (*Pagellus bogaraveo*, namely "voraz") have been developing along the Strait of Gibraltar area. Actually Spanish landings from this fishery cover almost the 70 % of the landings for the species in the ICES Sub-Area IX. The Instituto Español de Oceanografía (IEO) began the study and the fishery monitoring following the request from the Fishermen Corporations in 1997 and all the information available is presented in the Working Group on the Biology and Assessment of Deep Sea Fisheries Resources (WGDEEP) at the International Council for the Exploration of the Seas (ICES) from 2000 onwards. In 2006, 2008 and 2010 assessment trials were attempted in this forum.

However the assessed stock inhabits Atlantic and Mediterranean waters and also involves Moroccan and Spanish fishing boats. Thus, we are dealing with a "shared stock", fished by two or more countries. The SAC (Scientific Advisory Committee) of the GFCM (General Fisheries Commission for the Mediterranean) proposed the establishment of a joint *ad-hoc* Working Group meeting with Spanish and Moroccan scientists support by COPEMED, to analyze the existing information on the stock and fishery of *Pagellus bogaraveo* in the Strait of Gibraltar area.

This document summarizes the available information of the Spanish red seabream fishery in the Strait of Gibraltar.

The biology of the stock.

The red seabream (*Pagellus bogaraveo*) is found in waters on various types of bottom (rocks, sand, mud) to 300 m and 700 m (young near the coast, adults on the continental slope). Its

distribution area is as follows: Eastern Atlantic (from South of Norway to Cape Blanc in Mauritania, Azores, Madeira and Canary Islands) and Mediterranean Sea. Adults inhabit depths from 200 to 700 m. The vertical distribution of this species varies according to individual size (Desbrosses, 1938; Guegen, 1974; Silva *et al.*, 1994 and Gil, 2006).

As indicated in the ICES WGDEEP, in the NE Atlantic area stock limits are generally determined not only by biological considerations but also by agreed boundaries and coordinates. Thus, ICES considered three different components for this species in the Atlantic area:

- Areas **VI**, **VII**, and **VIII** (mainly Cantabrian Sea and Bay of Biscay)
- Area **IX** (including the Strait of Gibraltar)
- Area **X** (Azores Islands)

This separation does not pre-suppose that there are three different stocks of red seabream, but it offers a better way of recording the available information (ICES WGDEEP Report 2008). Several researches, particularly genetics and tagging, seem to support the current assumption of three assessment units. However possible links between red seabream from the Azorean region with the southern Subarea IX, Moroccan waters, Sahara Bank and Subareas VI+VII+VIII and the northern part of Division IXa have not been studied extensively.

The inter-relationships of the red seabream from areas VI, VII, VIII and the northern part of area IXa and their migratory movements within these areas have been observed by tagging methods and seasonal migrations have been reported (Gueguen, 1974). A tagging programme was also carried out in sub-area Xa (Azores Islands). Based on the results obtained up to now, no significant movements between areas (coastal, banks, seamounts) have been reported but local seasonal migrations are observed (Pinho, 2003). More recently, tagging has been done also in the Strait of Gibraltar (south part of ICES area IXa), 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). Figure 1 presents the different areas of these tagging experiences.

Genetic studies show that there are no differences between populations from different ecosystems within the Azores region (East, Central and West group of Islands and Princess Alice Bank) but there are genetic differences between Azores and mainland Portugal (Stockley *et al.*, 2005).

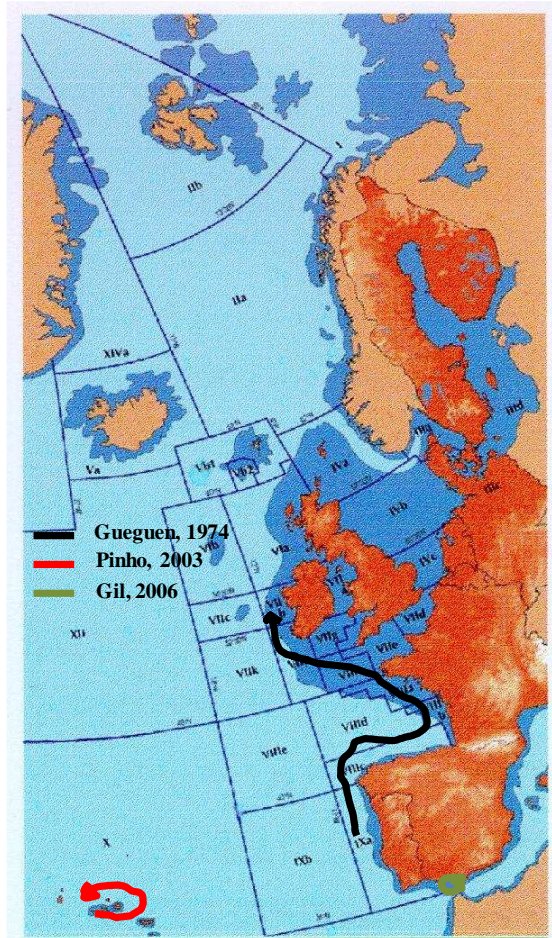


Figure 1. Red seabream tagging experiences in NE Atlantic.

In 2007, Piñera *et al.* suggests no significant genetic differences are present along Spanish coasts (Mediterranean and Atlantic areas).

Viral studies of *P. bogaraveo* are currently carried out by the Santiago de Compostela University. First analysis used tissue samples of spleen, kidney and brain of 33 fish from the strait of Gibraltar fishery. Only 2 fishes were completely free of viruses (6%). The remaining 31 were positive for one or more viruses. Only 1 fish was positive for betanodavirus. Betanodaviruses are classified in four different genotypes which seem to be a certain geographical distribution. Genomic sequencing of the PCR (Polymerase Chain Reaction) products obtained from the red seabream could give some clues about the distribution of the fish populations analyzed. Unfortunately, due to the low viral load, only one PCR product was sequenced and the results obtained are not conclusive (Bandín, *pers. com.*).

Migration patterns have been studied using tagging surveys in the Spanish South Mediterranean region and the Strait of Gibraltar (Gil *et al.*, 2001; Sobrino and Gil,

2001). Trap gears were utilized to catch red seabream juveniles in the Mediterranean Sea and adults in the commercial fishery area were caught with the “*voracera*” gear. Since 1997, 7066 samples were tagged (juveniles + adults) and at the moment 396 recaptures were notified. Recaptures from tagged juveniles show significant displacements from South Mediterranean breeding areas toward the Strait of Gibraltar. However, recaptures from tagged adults did not reflect big displacements, which are limited to feeding movements between the different fishing grounds where the “*voracera*” fleet works (Gil, 2006).

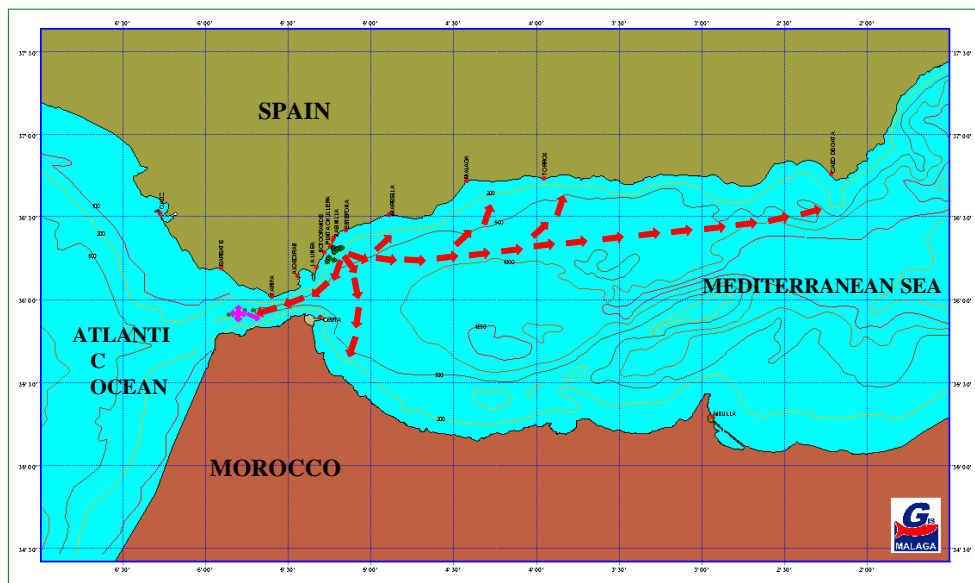


Figure 2. Location and movements from the red seabream tagged samples (Gil, 2006)

In the case of the Strait of Gibraltar it is obvious that red seabream also inhabit in Morocco waters. In fact recaptures of tagged fishes were also notified by Morocco fishermen. Thus its fishery is carried out in several areas belonging to different Regional Fisheries Management Organizations (RFMOs) as:

- International Council for the Exploration of the Seas (ICES Sub-Area IX).
- General Fisheries Commission for the Mediterranean (Southern Alboran Sea, GFCM Sub- Area 3).
- Fisheries Committee for the Eastern Central Atlantic (Morocco coastal, CECAF Division 34.1.1).

Fish do not understand these human boundaries, neither fishermen. Spanish available information is yearly assessing at ICES WGDEEP.

Growth: Red seabream is considered a slow growing species. Gueguen (1969)

reported a maximum age of 20 years. In the Azores Islands a maximum age of 15 years was observed in a 56 cm length fish (Krug, 1994).

In the Strait of Gibraltar area, growth was studied throughout monthly samples from landings of “*voracera*” fleet in the fishing port of Tarifa (Cádiz, SW Spain) along the years 1997-1999 and 2003-2009. Generally, rapid growth rings (opaque) are formed in summer-autumn and slow ones (translucent) in winter-spring (Morales-Nin, 1987). The alternation in the deposition is clear of organic matter, bigger or smaller, and confirms the annual rhythm of the growth rings.

Thus, the ring formation pattern is clearly apparent in the whole otolith with one opaque and one translucent zone being laid down every year. Whole otoliths (*sagitta*) were read under a light microscope to record the number of rings and their edge type (Figure 3). January 1st was assigned as birth date. Age Length Key (ALK) was created from at least three agreed readings.



Figure 3. Otoliths extraction (left) and 2 years old agreed reading otolith (right)

The Von Bertalanffy growth function (VBGF) was fitted to the mean length at age data (from the ALK) to estimate growth parameters, fixing the L_{∞} value, from the largest observed sample (FISHPARM software).

Besides, VBGF parameters were also estimated in the Strait of Gibraltar from the increasing size of 271 recaptures (FISAT II software).

Growth parameters can be compared using the “Phi-prime Test” (Munro & Pauly, 1983) that contrasts the different growth global yield indexes (ϕ') obtained according to:

$$\phi' = \log_{10} k + 2 \log_{10} L_{\infty}$$

Table I. Red seabream estimated Von Bertalanffy Growth Parameters in different areas

Author	Study Area	Methodology	t0	k	L ∞	Phi (ϕ')
Ramos, 1967	Cantabrian Sea	Otoliths reading	-1.02	0.127	53.86	2.57
Gueguen, 1969	Cantabrian Sea	Otoliths reading	-2.92	0.092	56.80	2.47
Sánchez, 1983	Cantabrian Sea	Otoliths reading	-0.53	0.209	51.56	2.74
Krug (1982-1985), 1994	Azores Islands	Otoliths reading	-0.91	0.118	58.89	2.61
Krug (1987-1991), 1994	Azores Islands	Otoliths reading	-0.39	0.121	64.18	2.70
Menezes <i>et al.</i> , 2001	Azores Islands	Otoliths reading	-1.08	0.135	56.67	2.64
Pinho, 2003	Azores Islands	Otoliths reading	-1.29	0.102	62.24	2.60
Sobrino and Gil, 2001	Strait of Gibraltar	Otoliths reading	-0.67	0.169	58.00*	2.75
Gil <i>et al.</i> , 2008	Strait of Gibraltar	Otoliths reading	-1.23	0.169	62.00*	2.77
Gil <i>et al.</i> , 2009	Strait of Gibraltar	Otoliths reading	-0.34	0.162	62.00*	2.79
Gil <i>et al.</i> , 2008	Strait of Gibraltar	Recaptures ⁽¹⁾		0.079	62.00*	2.48
Gil <i>et al.</i> , 2008	Strait of Gibraltar	Recaptures ⁽²⁾		0.098	62.00*	2.58
Gil <i>et al.</i> , 2008	Strait of Gibraltar	Recaptures ⁽³⁾		0.161	62.00*	2.79
Gil <i>et al.</i> , 2008	Strait of Gibraltar	Recaptures ⁽⁴⁾		0.080	62.00*	2.49
⁽¹⁾ Gulland y Holt, 1959 ⁽²⁾ Munro, 1982 ⁽³⁾ Fabens, 1965 ⁽⁴⁾ Appeldoorn, 1987						
*Fixed (from the largest observed sample)						

Table I shows different estimates of Von Bertalanffy Growth Function (VBGF) parameters. The phi-prime test (ϕ') provides an indication of the estimates reliability because different values for the same stock indicate that one or both estimates could be biased. On the other hand, growth curves for the same species may be very different despite having similar ϕ' values.

The ϕ' values ranged from 2.47 (Gueguen in the Bay of Biscay) to 2.75 (Strait of Gibraltar) with a mean of 2.64. Strait of Gibraltar values from otolith readings (Sobrino and Gil, 2001) are similar for other distribution areas of the species, mainly with the obtained by Sánchez (1983) for the Cantabrian Sea population. From these results similar growth patterns can be assumed for the red seabream in all the areas. This assumption does not denote a single stock: Growth patterns are similar but not the same.

Reproduction: The species reproductive type is hermaphroditic. It is considered to be protandric and most males change sex to females (Krug, 1990). Juveniles and adults are associated with particular topographic features and sea-bed substrates. Juveniles are frequently observed in shallower waters (<100 m) near estuaries, while adults reside in deeper waters, especially near banks (Bauchot *et al.*, 1986). Hermaphrodite fish in the Strait of Gibraltar area were observed, in lengths between 20 and 32 cm. Almost all larger fish, were females and spawning seems to take place in the Strait of Gibraltar area, where the fishery is carried out (Gil, 2006). Reproductive biology of the Red seabream of the Strait of Gibraltar was studied throughout monthly samples from landings of artisanal fleet (“voracera”) in the

fishing port of Tarifa (Cádiz, Spain). For each specimen sampled, the total body length, total and gutted body weight and gonad weight were recorded. The number of males, females and hermaphrodites and its gonad macroscopic stages of maturation were recorded too. The reproductive season for males and females was determined by means of the GSI monthly evolution. This information was tested with the monthly trend of the different maturity stages (EMS) of males and females gonads (Figure 4 and Figure 5). According to these values the spawning season seems to take place during the first quarter of the year (Gil and Sobrino, 2001). These estimates coincide with those obtained by Krug (1994) for the Azores Islands (ICES Division X) and with previous studies from Cantabrian Sea by Sánchez (1983), Alcaraz *et al.* (1987) and Castro (1990) in ICES Sub-area VIII (Cantabrian Sea).

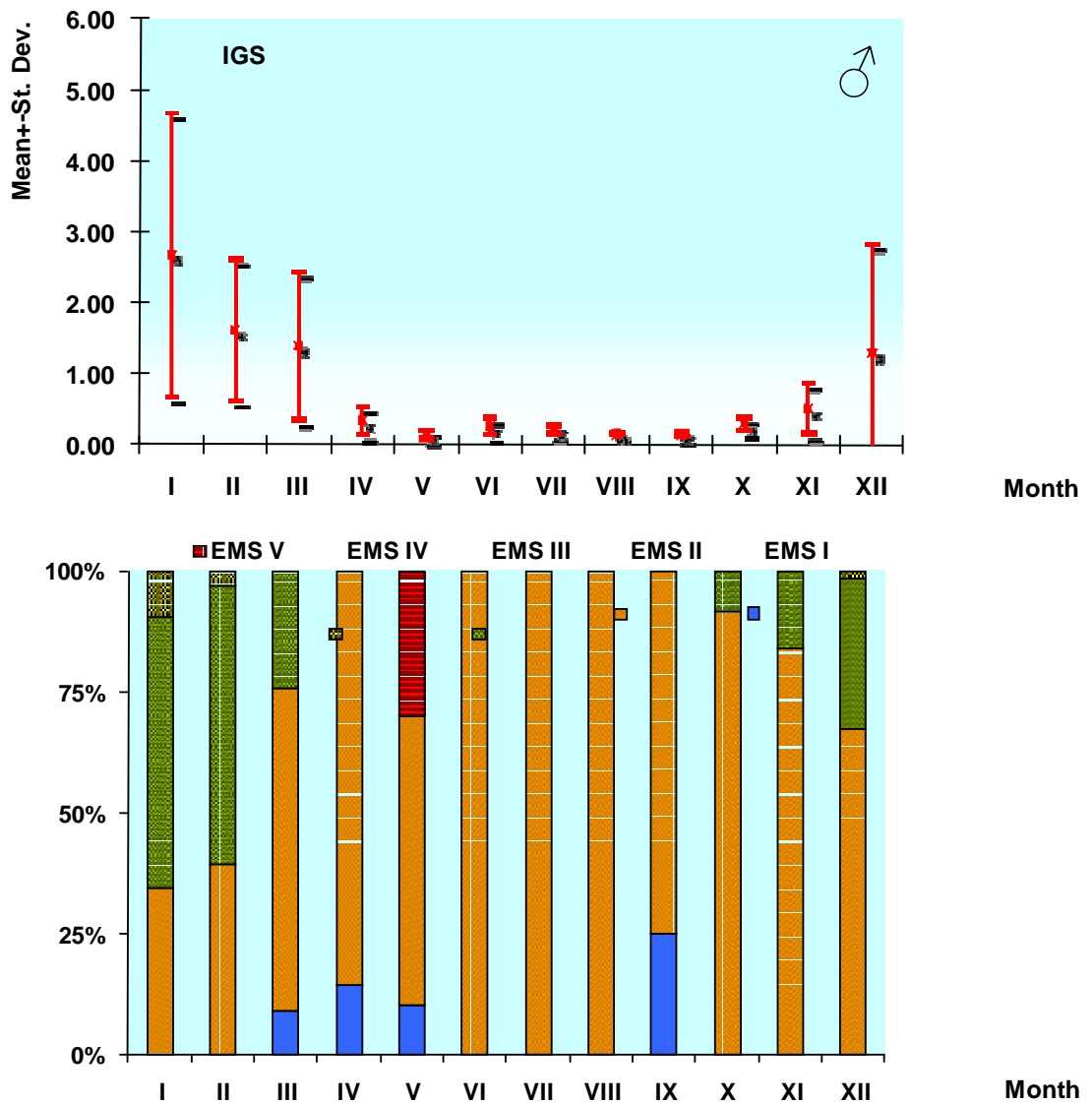


Figure 4. Red seabream of the Strait of Gibraltar: Males maturity stages and GSI monthly evolution (from Gil and Sobrino, 2001)

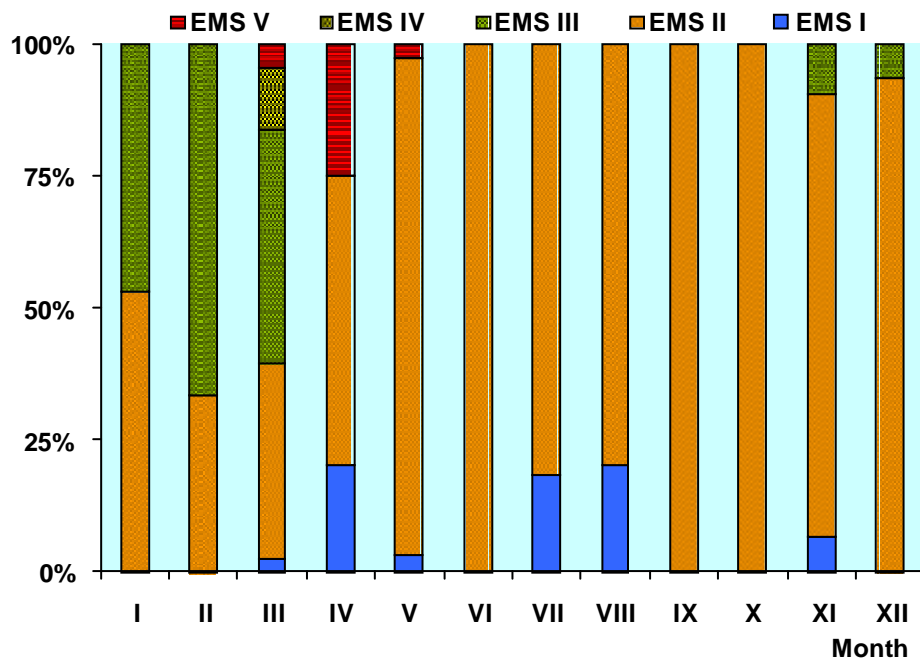
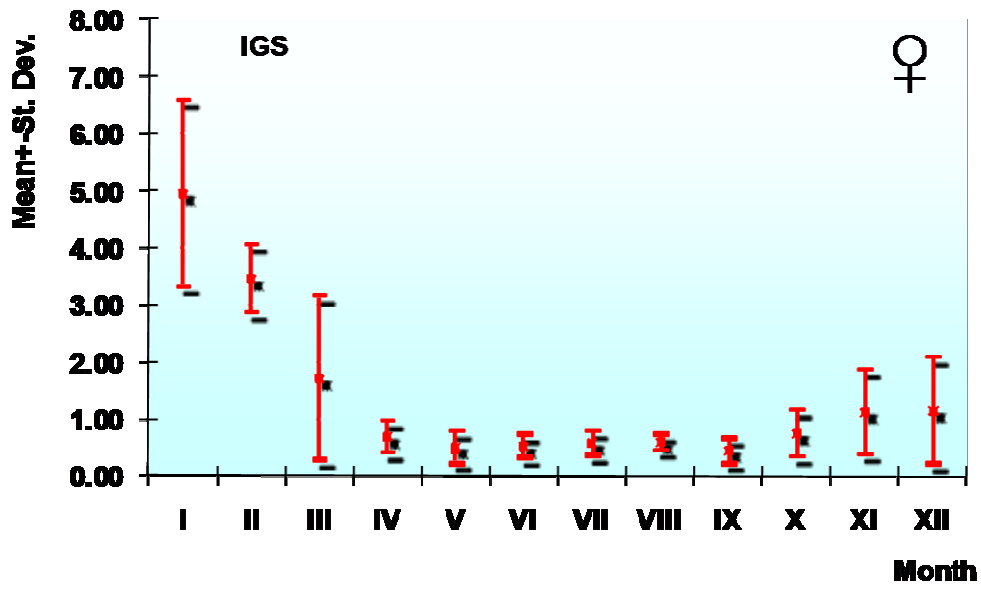
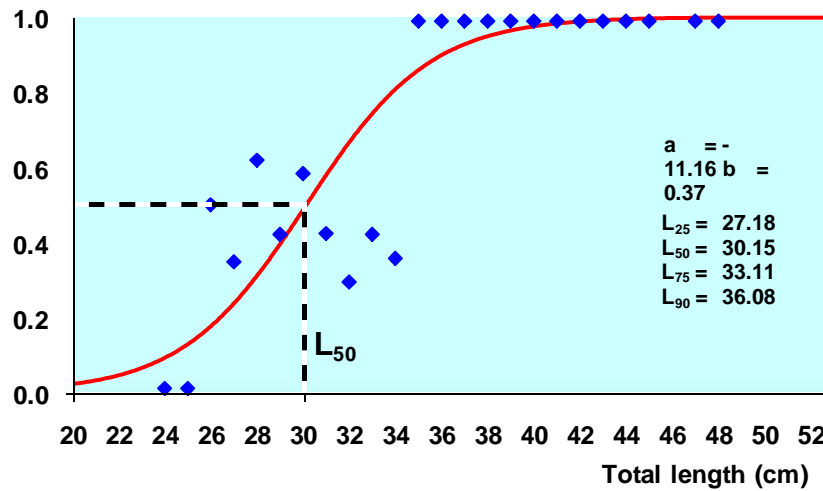


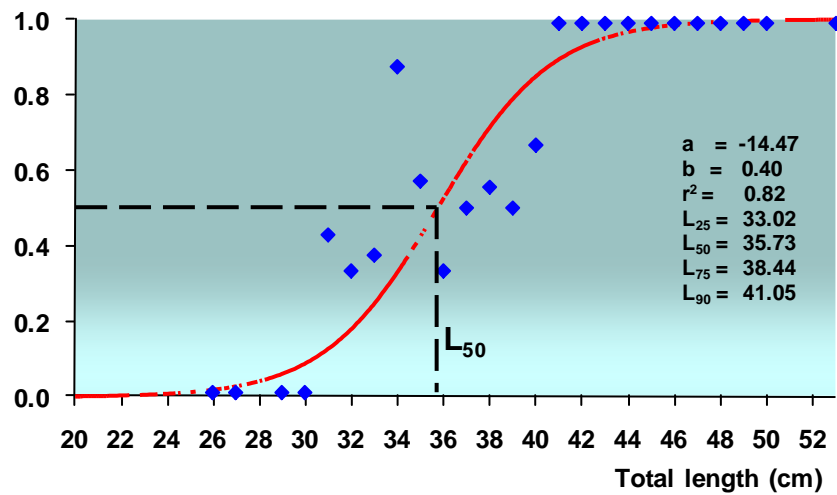
Figure 5. Red seabream of the Strait of Gibraltar: Females maturity stages and GSI monthly evolution (from Gil and Sobrino, 2001)

L_{50} was determined by sexes after adjusting for a log normal distribution on the curve showing the percentage of mature specimens (EMS III to V): $P_i=1/(1+e^{(a+bTL)})$

The smallest specimens are mainly males maturing at $L_{50}=30.15$ cm (Figure 6a). Later an important part of the individuals changes its sex (sexual transition) and the females maturing occurs at $L_{50}=35.73$ cm (Figure 6b).



(a)



(b)

Figure 6. Red seabream of the Strait of Gibraltar: Percentage of mature individuals: (a) males (b) females (from Gil and Sobrino, 2001)

In 1987, Alcaraz *et al.* estimated L_{50} from 25 to 29 cm in males and from 30 to 34 cm in females for the red seabream population of the Cantabrian Sea. Krug (1994) gives values for the red seabream of the Azores Islands in three different periods: 1982-1983, 1984-1986 and 1991. Males were 26.44, 28.2, and 28.24 cm, respectively. While females L_{50} decreases along time, with estimated values of 34.45, 33.93 and 32.31 cm. A more recent study by Mendonça *et al.* in 1998 about reproductive aspects of several demersal species from the Azores Islands, propose lengths at first maturity of 26.2 cm for males and 29.2 cm for females. Size measure chosen in the case of Azores Islands was fork length instead of total length. So the available values of the Azores population will always be lower than those obtained in the Strait of Gibraltar works (Gil, 2006).

The estimated values for the population of the Strait of Gibraltar are close to those obtained by Alcaraz *et al.* (1987) in the Cantabrian Sea. Besides despite the wide range estimated, authors stress that the estimated values come mainly from the higher lengths of each range. Therefore, there are no large differences between the lengths at first maturity estimated for the population of the Cantabrian Sea and the Gibraltar Strait.

More recently Jiménez (2010) suggest lower L_{50} values for the Strait of Gibraltar red seabream population in both sexes (Males L_{50} = 24.4 cm and females L_{50} = 28.2 cm). In this case the proportion of mature individuals was established by microscopic criteria. This fact highlights the needs about the development of workshops on several aspect of the species reproduction as maturity stages, hermaphroditism, etc.

According to Buxton and Garratt (1990) the red seabream should be considered as a batch spawner and its early life stages (*larvae*) was described by Karrer in 1984 in the NW African coast. Larvae are pelagic, floating in the water column just below the thermocline (Lo Bianco, 1909; Giovanardi and Romanelli, 1990). Currently, no scientific literature about red seabream early life stages exists for the Strait of Gibraltar area.

Feeding: Feeding habit of this specie 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 stomachs contents of *Pagellus bogaraveo* were recently analyzed: 725 stomachs were empty and 381 were fullness. Vacuity index (VI) was 66%. The trophic spectrum is composed of 24 prey taxa, 6 orders, 11 families and 15 species

and genera are represented. Despite the trophic spectrum diversity observed, the overall diet is not very diverse (Figure 7), mainly composed by *Sergia robusta* as main prey while the order teleosts Stomiiformes can be considered as a secondary prey. Other appearing species are *Lampanyctus crocodiles*, *Lophogaster typicus*, *Argyropelecus hemigymnus* and *Chauliodus sloani* (Polonio *et al.*, 2008).

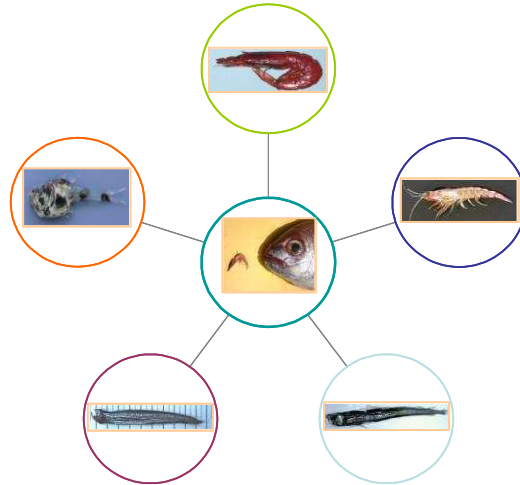


Figure 7. Main preys of the red seabream in the strait of Gibraltar (from Polonio *et al.*, 2008)

Main predators are unknown in the Strait of Gibraltar waters but maybe dolphins' predation should be taken into account (personal communication from Ceuta veterinary). 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). Natural mortality (M): Its value depends on the biological characteristics of each stock and the cohorts that compose it (Pereiro, 1982). An estimate is simpler in case of unexploited stocks, M is close to Z, but is complicated in the case of fully exploited stocks.

Table II. Red seabream natural mortality rates estimates and its longevity values (T_e) (from Gil, 2006)

Methodology	M	T_e
Taylor, 1958	0.18	26 years
Beverton y Holt, 1959	0.33	14 years
Tanaka, 1960	0.20	23 years
Rikhter y Efanov, 1976	0.32	14 years
Pauly, 1980	0.26	18 years
ICES WGDEEP*	0.20	23 years

* Value adopted for demersal species in the absence of other information.

The obtained values vary along a wide range and the choice of a single value is not an

easy task. Thus, the natural mortality of *Pagellus bogaraveo* should be considered as uncertain because there is no data available to estimate M directly. A mortality rate of 0.2 year⁻¹ has been adopted by several authors in different papers from the Azores Islands (Silva, 1987; Silva *et al.*, 1994; Krug, 1994, Pinho *et al.*, 1999 and Pinho, 2003).

A brief journey through the species life history could be: Later the spawning season, currents moves eggs and larvae to both sides of the Strait of Gibraltar. Red seabream spends its early years in coastal areas (bays, breakwaters and even inside ports). Later, ventured to move away from these shelter areas. Once recruited to the fishery (since three years) it seems to remain in the Strait of Gibraltar area continuing their growth and taking place other life events as: maturation, spawning, sexual change....In this area cohabit different ages that originate the distribution of the landings in four commercial categories (as result of the individuals weight). **The fishery**

Since the earlies 1980's an artisanal fishery targeted to the red seabream (*Pagellus bogaraveo*) have been developing along the Strait of Gibraltar area. Primarily, around 25 boats carried out the fishery in 1983 and the fleet has been increasing up to more than a hundred from the 1990's (Figure 8).

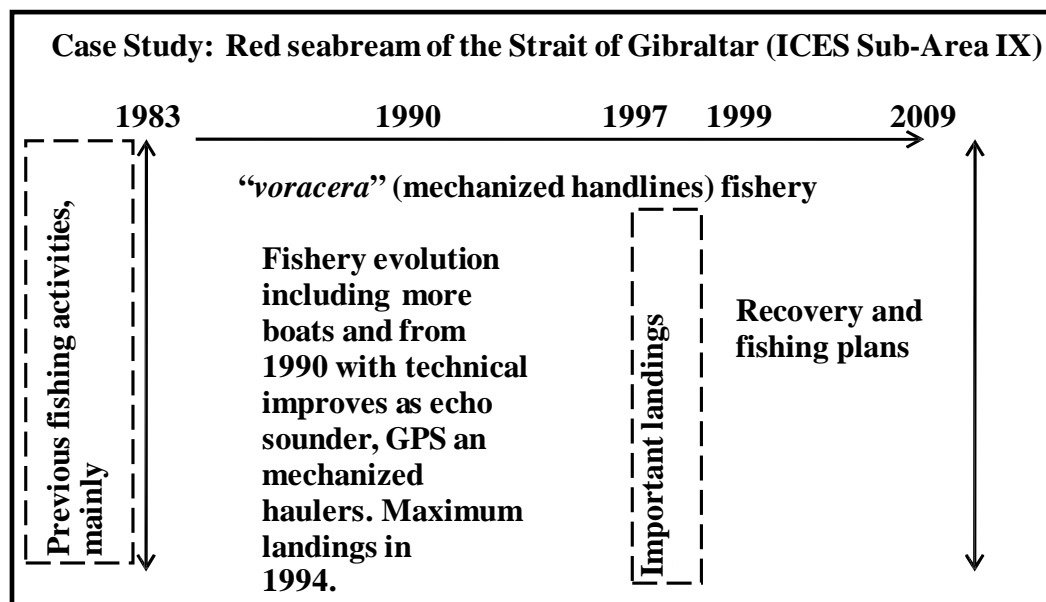


Figure 8. Red seabream fishery of the Strait of Gibraltar: Spanish fishery development summary

- **Fleets and gears:** Technical characteristics are extracted from the boats included in the last authorized vessels list. Maybe engine power should be underestimated because of taxes. Length= 9.80, 5.50 – 15.00, 2.14 (mean, range, standard deviation). GRT= 6.36, 1.07 – 19.00, 4.20 (mean, range, standard deviation).

HP= 47.23, 11.04 – 132.45, 29.05 (mean, range, standard deviation).

Generally each boat has a crew of 3-5 people. Trip lengths are no longer than a day. The “*voracera*”, a local mechanized hook line baited with sardine, is the gear used by the fleet from Tarifa and Algeciras ports (Figure 9). Each line (“*voracera*”) attached a maximum of 100 hooks (usually ± 70). Fishing is carried out taking advantage of the turnover of the tides in bottoms

from 200 to 400 fathoms. Target species are distributed in categories due to the wide range

of sizes and market reasons. These categories vary along the time. Red seabream is daily sold fresh in local market and then moved to other places of the Iberian Peninsula and also other EU countries (mainly Italy).



Figure 9. Red seabream Spanish fishery in the Strait of Gibraltar: Boat, gear and haulers

Nowadays, the red seabream of the Strait of Gibraltar is sold according 4 market categories (Figure 10): >1300 grs (namely “*burros*”), from 850 to 1300 grs (namely “*tamaño*”), from 550 to 850 grs (namely “*mediano*”) and from 350 to 550 grs (namely “*pequeño*”).



Figure 10. Red seabream Spanish fishery in the Strait of Gibraltar: Different sizes of the target species

- **Fishing statistics:** Fishery information was gathered for the period 1983-2009 from the sale sheets: Monthly landings, monthly number of sales and the number of days in which those sales were carried out. Moreover, from the beginning of the IEO monitoring (June 1997) an *ad hoc* monthly length samplings from the different commercial sizes are carrying out to estimate the landings length distribution (Gil *et al.*, 2000).

Besides, since 2008 are available information from a sort of VMS system (namely “*cajas verdes*”). These data were processed taken different parameters into account (mainly time, position, speed and direction) to discriminate soak and trip positions. Thus the fishing footprints obtained includes only those positions where the algorithm employed consider that a fishing haul was carried out.

Fishing grounds: Figure 11 shows the fishing footprint for the whole 2008 year, including only those positions where the algorithm employed consider that a fishing haul was carried out. So represents the activity from only a fleet type (“*voracera*”) in a quite small area (Strait of Gibraltar) with fishing grounds more or less defined.

Besides, with the support of different Institutions (mainly Junta de Andalucía), from 2005 to 2009 a scheme of observers on board “*voracera*” fleet has been carried out. Sampling level was 5 boats and 3 trips per month. Caught species were recorded in number (including length distribution).Figure 12 shows the footprint which is so similar to the obtained from the VMS analysis. The information from these boats could be used as a tuning fleet in a future XSA (eXtended Survivors Analysis) fishery assessment.

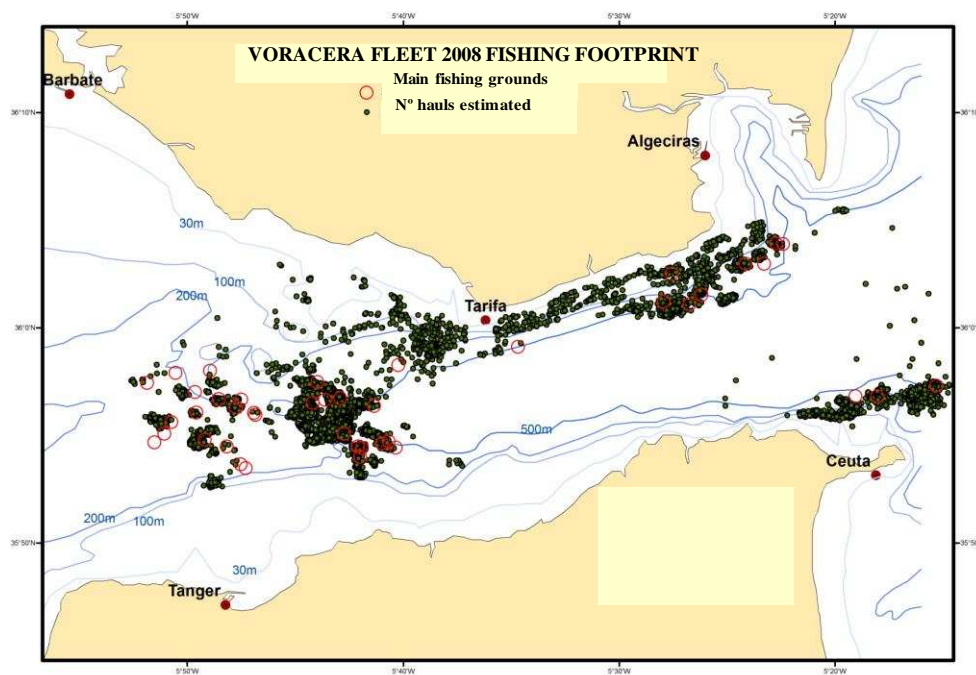


Figure 11. Red seabream fishery of the Strait of Gibraltar: 2008 Spanish “*voracera*” footprint

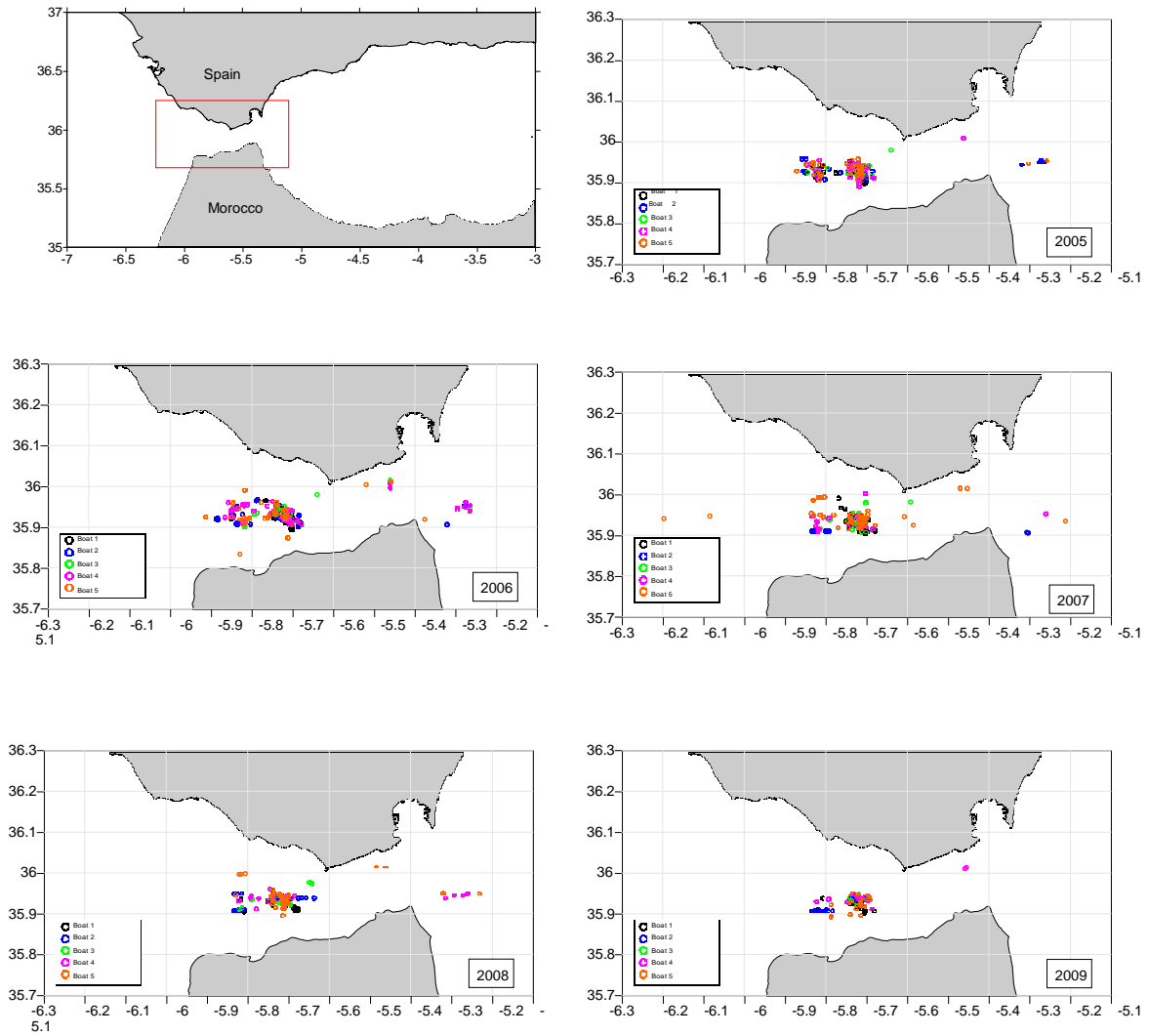


Figure 12. Red seabream fishery of the Strait of Gibraltar: Yearly soaking positions footprints from observers on board

Landings data: Spanish red seabream fishery in the Strait of Gibraltar is almost a monospecific fishery with one clear target species. *Pagellus bogaraveo* represents the 74% from the total landed in average percentage in the period 1993-2003 (Table III) which constitutes a fleet component by himself (Silva *et al.*, 2002).

Table II. Red seabream Spanish fishery of the Strait of Gibraltar: Species landed, in percentage, by the “voracera” fleet (from Gil, 2006)

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Species
77	95	59	75	61	70	92	47	87	73	69	<i>P. bogaraveo</i>
0	1	35	11	26	5	5	51	2	0	0	<i>B. brama</i>
5	0	5	14	13	20	1	1	0	0	2	<i>T. thynnus</i>
0	0	0	0	0	0	0	0	7	16	21	<i>L. caudatus</i>
0	0	0	0	0	0	0	1	1	7	7	<i>Trachurus spp.</i>
0	0	0	0	0	0	1	0	1	0	0	<i>H. dactylopterus</i>
0	0	0	0	0	0	0	0	0	0	0	<i>P. americanus</i>
0	0	0	0	0	0	0	0	0	0	0	<i>E. guaza</i>
19	4	1	1	0	5	0	1	2	3	1	Other fishes

The landing species percentages are not constant: Highest value for red seabream was 95% in the year 1995, while the lowest was 47% along the year 2000 coinciding with the maximum value for atlantic pomfret. We must clarify that tuna fishery is a summer alternative for the red seabream one; so, obviously, the gear (number and size of hooks) and the bait are quite different. Thus, the associate species to the red seabream fishery are: red seabream as target species with silver scabbardfish, atlantic pomfret, rockfish, horse mackerel and in a minor way wreckfish and conger eel as concurrent species (Gil, 2006).

Figure 13 shows a continuous increase of the landings to a maximum in 1994. Since 1994 landings have gone decreasing, except in 1996 and 1997, till the lowest value of the recent years in 2002. Then, from 2003 onwards it shows an increasing trend till reached the highest value of the last years in 2009 (over the landings permitted within the Regional Fishing Plan).



Figure 13. Red seabream fishery of the Strait of Gibraltar: Spanish landings (1983-2009) (from Gil *et al.*, 2010)

LPUEs: Fishing effort increases too (Figure 14). The simultaneous increasing trend of landings and effort, from the beginning of the fishery up to 1994, became in higher LPUEs values in the early period (1983-1994). This could be interpreted as an improvement of the effectiveness of fishing gear instead of a real increase in the resource abundance.

Currently the effort unit chosen (number of sales) cannot be too appropriate, as do not consider the missing effort (boats with fishing trips but no sales). Thus, in the recent years this missing effort increases substantially. Then recent LPUEs should be interpreted with caution because it cannot be a real image of the resource abundance.

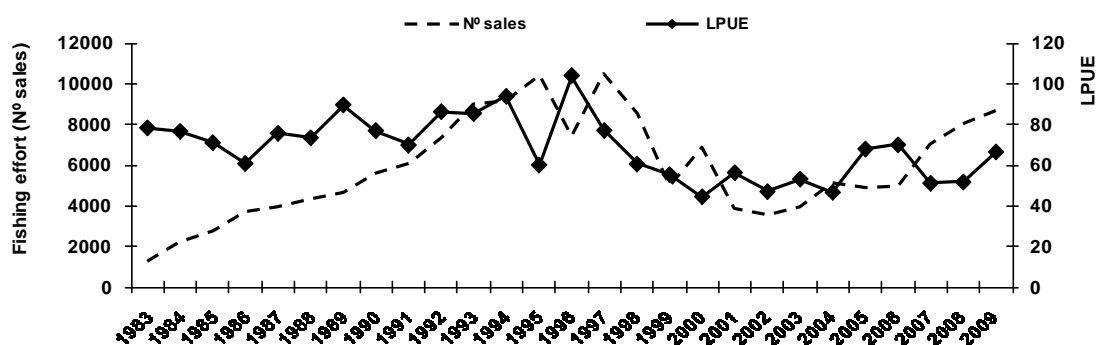


Figure 14. Red seabream fishery of the Strait of Gibraltar: Evolution of the chosen effort unit (nº of sales) and estimated Spanish LPUE (1983-2009) (from Gil *et al.*, 2010)

Landings length frequencies: From the beginning of the IEO study, in June 1997, an *ad hoc* monthly length samplings from the different commercial sizes are carrying out to estimate the landings length distribution. Precedents length distributions (1983-1996) were estimated raising categorized length distribution to landings by commercial size. At the end of 1989 was a change in the classification of commercial categories, so those first years (1983-1989) should only take into account as a proxy. The fishery resource suffers a decrease of the landed mean length (Figure 15) mainly from 1995 to 1998.

It is necessary to point out that species probably does not have a homogeneous geographic and bathymetric distribution related to their length. This fact could explain the different landed mean length between ports (Tarifa and Algeciras).

The mean length of the landings gets progressively increasing from 1999 onwards, but along the last years the trend varies increasing again from 2006 on in both ports. However the median value from these years remains under the mean in every case and more close to the minimum landing size in Algeciras.

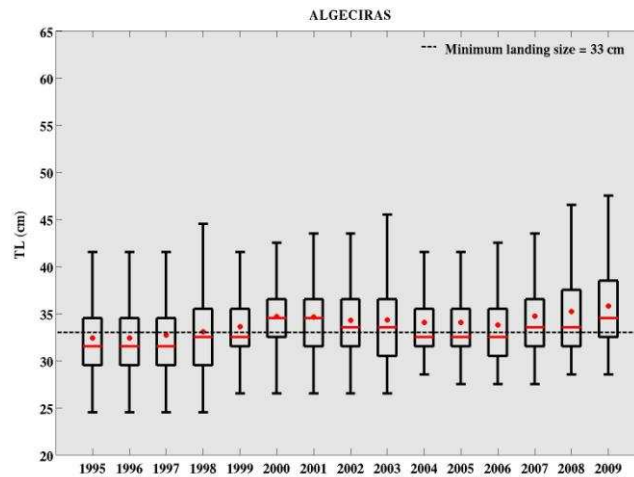
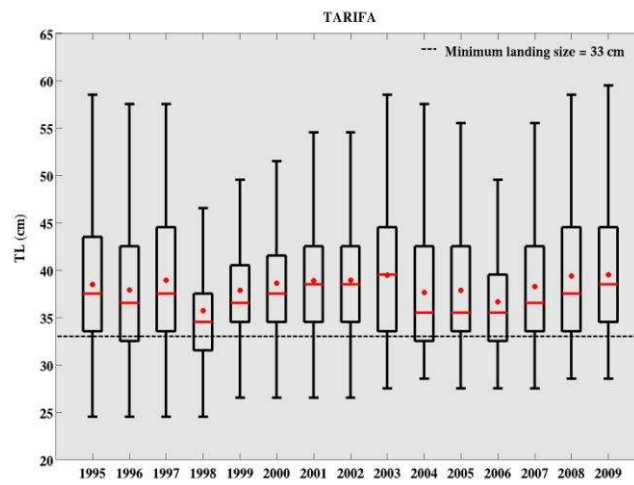
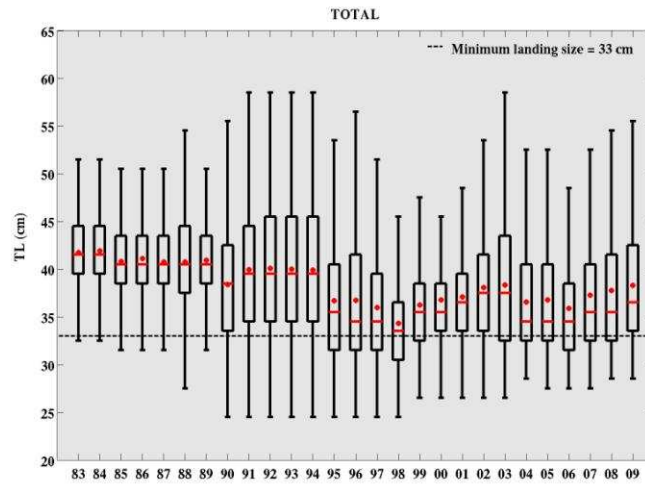


Figure 15. Red seabream fishery of the Strait of Gibraltar: Evolution of the Spanish landings length distribution descriptive statistics (mean, median and percentile values) (from Gil *et al.*, 2010)

Stock assessment

- Summary of methodologies currently used by ICES

Historical series of landings data available to the Working Group have been 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 seabream in IX included Spanish and Portuguese landings from 1990 onwards (Table III). Landing length frequencies data are only available for Spanish red seabream fishery in the Strait of Gibraltar and it is raised to the total landings of the Sub-Area IX. Annual age frequencies (catch at age) were derived by the application of the combined Age Length Key from Strait of Gibraltar samples to the Sub-Area IX landings length distributions. Age 4 individuals are the most represented in the landings, even in the early years.

Table III. Red seabream (*Pagellus bogaraveo*) in Subarea IX: Working Group estimates of landings (tonnes) (from ICES,2010)

Year	Portugal	Spain	TOTAL
1988	370	319	689
1989	260	416	676
1990	166	428	594
1991	109	423	532
1992	166	631	797
1993	235	765	1000
1994	150	854	1004
1995	204	625	829
1996	209	769	978
1997	203	808	1011
1998	357	520	877
1999	265	278	543
2000	83	338	421
2001	97	277	374
2002	111	248	359
2003	142	329	471
2004	183	297	480
2005	129	365	494
2006	104	440	544
2007	185	407	592
2008	158	444	602
2009*	124	594	718

Weights at age were assumed to be the same in both the catch and the stock. These were estimated according to the ALK and the length-weight relationship presented by Gil *et al.* to the WG. As a result of the application of an unique ALK to all the series, the weights at age do not present a lot of variation along the years because differences are only related to the landings length distribution variability. For all the assessment exercises, mean weight at age in the stock was considered equal to the mean weight at age in the catch. Besides, 0.2 year^{-1} could be adopted as a natural mortality value and considered it the same for all ages along the period studied. Female maturity ogive estimated by Gil and Sobrino in 2001 could be used and considered the same over time. Proportion of F and M before spawning could be considered 0 because the spawning season takes place in the first quarter of the year. And finally, the oldest age group (10) should be consider (or not) as plus group (10+) because at least one sample is recaptured 10 years after the tagging.

From this information Lowestoft software required files could be created to attempt VPA exploratory runs. Without tuning fleet information, Separable VPA could be used in order to define terminal F of the analysis (Gil *et al.*, 2009).

Several exploratory analyses were attempted to select the required parameters for a separable VPA. Selection pattern from $S=0.4$ seems to be reliable related to a hook fishery and also sum of squares residuals are the lowest of all the S choices, although all obtained are very close. Different options of F could be considered, although preliminary Z estimate from catch curves is lowest than 0.4.

From these trials, the choices that seem the most reliable option for the assessment exercise are: Reference age=4, $S=0.4$ and $F=0.3$ (considering closest values of the sum of squares residuals and the preliminary Z estimate) despite the results sensibility to the plus group use, mainly in the first years of the series (ICES, 2006).

- Revision of the status from the last assessment (2010)

The assessment exercise was an update from the 2006 and 2008 attempts and still carried out under the same uncertainties. ALKs computed from one year must not be applied to samples taken in a different year, because they could give biased results (Westrheim and Ricker, 1978). As in previous years, SSB differences dues to the use, or not, of a plus group do not so important in the recent years. In both cases the SSB decreasing trend is clear enough. Current SSB remains at the lowest value in the time series (Figure 16).

As in previous years, the assessment attempt was considered as an exercise due to its related uncertainty and its results was examined only in qualitative terms.

Thus, no reliable assessment can be presented for this assessment unit and fishing possibilities cannot be projected. No reference points have been defined for this assessment unit.

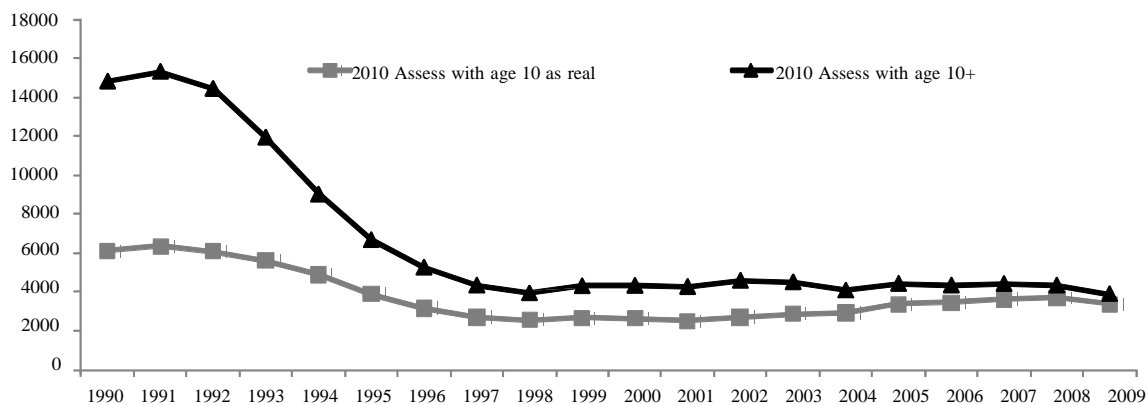


Figure 16. Red seabream (ICES Sub-Area IX): SSB estimates from traditional VPA (separable analysis with reference age:4, S=0.4, F=0.3, default weighting values and considering, or not, age 10 as a plus group) (from ICES, 2010).

Anyway, based on the assessments attempts, the recent increasing trend of landings in the fishery may be considered unsustainable. Thus, despite the uncertainty of the assessment exercise, fishing mortality rates should be reduced until reliable assessments prove the fishery sustainability. In this context, as in previous years (Table IV) ICES advises “*that catches in 2011 should be less than 500 t which is a reduction from 2008 - 2009 landings*” (ICES ADGDEEP 2010).

Table IV. Red seabream (*Pagellus bogaraveo*) in Subarea IX: Historical review of ICES Advice.

Year	ICES Advice	Predicted catch corresp. to advice	TAC EU Subarea IX	ICES landings Subarea IX
2003	¹	-	1.271	0.47
2004	¹	-	1.271	0.48
2005	¹	-	1.271	0.49
2006	¹	-	1.271	0.54
2007	¹	-	1.080	0.59
2008	¹	-	1.080	0.60
2009	Constrain catches to average catches 2003-07	0.5	0.918	0.72
2010	Biennial	0.5	0.780	
2011	Same advice as previously	0.5		

Weights in '000 t.

¹Advice prior to 2008 included for all areas

Critical areas for *Pagellus bogaraveo* within the subregion. Useful documents.

On the biology: The main gaps in knowledge regarding life history patterns and general species ecology can be summarized in:

- Ageing: Consistency of the age readings between the readers and different areas (Strait of Gibraltar and Azores) should be checked. Therefore, otolith exchange between Spain and Portugal that are currently ageing this species is recommended to estimate precision and relative/absolute bias in the age estimations from age readers from different laboratories.
- Reproductive pattern: Role of hermaphroditism in the catch composition? Where are the potential spawning grounds? What about the earlier life stages?
- Feeding biology: Relationship with the special features (productivity) of the strait of Gibraltar. Differences between life stages and within ages? Which are the potential predators?
- Movements: is there a migratory pattern? Is it seasonal? Is it uni- or multi-directional? Why is the species migrating (feeding, spawning, wintering)? Is segregation by sex or age classes occurring?

So, dedicated research initiatives and biological sampling (gonads, stomachs, hard parts for ageing) are needed to solve uncertainties on various aspects such as: Reproductive patterns, hermaphroditism, length at first maturity, spawning biomass, natural mortality... all of them hindering the reliable assessment of the stock.

Besides, from an ecosystem point of view, stock dynamics of *Pagellus bogaraveo* seems to be highly affected by environmental variability at several scales. This is a benthopelagic species, feeding mainly in the water column, and so, changes on the water mass structure or on the distribution of the preferential prey species may introduce severe catchability problems. Also, fisheries should be considered one of the sources of man impact in the ocean. Despite hooks and lines have been considered less impact gears in the marine environment studies about its effects on the seabed will be welcome.

On the fishery statistics: It is important to emphasize that the effort unit chosen cannot be too appropriate as do not consider the missing effort. Thus, in the recent years this missing effort increases substantially (fishing vessels with no catches and precisely why with no sale sheet to be recorded). This way it is advisable to interpret with caution the LPUE trend in the last years because it cannot be a real image of the resource

abundance. Need of LPUE standardization. The enforcement of the management measures (mainly the minimum landing size) should increase the discard of the target species. Landings length distribution in 2010 shows a knife edge shape in the smaller market category. As far as we know the gear (hook size) still the same. This fact can be solved with the continuity of observers on board program to estimate the discards generated.

Samplings for estimate landing length distribution are currently carried out in the fish market stratified by commercial categories. Nowadays the CE support concurrent sampling by metier which usually is carried out on board (includes all the species). In the case of the Strait of Gibraltar significant differences are shown between raised length distribution from market and from observer on board because different red seabream sizes related with the fishing grounds. A proper length sampling program should be defined.

On the assessment: The use of a unique (combined) Age Length Key (ALK) to transform length data into age data for the assessment. Combined ALK must not be applied to samples taken in a different year, because they could give biased results (Westrheim and Ricker, 1978) and does not take into account possible growth differences between years. Since 2006 assessment trials were attempted by separable VPA because the absence of tuning fleet data series. From 2010 onwards XSA exercises can be attempted using the available tuning information from onboard observers program (2004-2009). However, the problem about the using of a combined ALK remains. Unresolved modelling issues could be tackled with a modern statistical catch-at-age model, rather than VPA. That approach would be better suited to make explicit modeling assumptions and portray the uncertainty in probabilistic terms (because should be easier to see how each model fits the catch-at-age data and compare the goodness of fit in likelihood terms).

The absence of reliability of the effort unit should be considered in case of production models assessments attempts.

Useful documents:

Along the last years large papers has been written about the Spanish red seabream fishery of the Strait of Gibraltar. Some of them are more accessible to the research community while much of the acquired knowledge has been presented in more restricted forums (“*grey literature*”). Thus, several documents have been submitted to

the Junta de Andalucía (Reports) according the agreement with the Instituto Español de Oceanografía (IEO) for the fishery monitoring. Besides, the available information about the Spanish fishery is presented every year to the ICES WGDEEP and is also included in the respective ICES WGDEEP Reports. Deepwater fisheries pose particular difficulties for management. Target species are difficult to assess with high levels of uncertainty, they are generally vulnerable to overfishing. Under the support of the 7th Frame Work Programme by the European Union, **DEEPFISHMAN Project (Management and Monitoring of Deep-sea Fisheries and Stocks)** will develop a range of strategy options for the management of deepwater fisheries in the NE Atlantic that will take account of these factors. Firstly, the aim will be to identify new and more effective assessment methods, reference points, control rules and management strategies to be used in the short term, making better use of available data. Secondly, a reliable long-term framework will be developed for which additional data needs will be specified in order to fill current information gaps to achieve reliable long-term management requirements. This work will be developed by examining a range of case studies selected to reflect the diverse characteristics of the different types of deepwater fishery found in the NE Atlantic. One of the cases of study included in the project is the Spanish red seabream fishery of the Strait of Gibraltar. Available information about this ongoing project (2009–2012) can be look at the wiki web address (<http://deepfishman.hafro.is/doku.php>).

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