

REPORT:

REPORT ON MARKING-RECAPTURE EXPERIENCES OF RED SEA BREAM IN THE AREA OF THE STRAIT OF GIBRALTAR MADE BY INSTITUTO ESPAÑOL DE OCEANOGRAFÍA (IEO)

Introduction

Along the broad Iberian coast there are multiple fishing grounds on which the fishing activity is practiced. This is an important source of wealth and has a high economic and social interest, with particular significance in some Autonomous Communities, due to its derivative effects: supplies and shipbuilding, transformation industry. The red sea bream (*Pagellus bogaraveo*) has always been considered a species of high commercial interest, fully integrated into the diet and the Iberian cuisine and traditionally present among the most requested fresh fish. It is a demersal species found in the waters of the northeast Atlantic and the Mediterranean Sea. In the Andalusian coast it is present, in smaller numbers, in Mediterranean fishing ports (Carboneras, Roquetas, Motril and Marbella) being more abundant in the area near the Strait of Gibraltar, in the towns of Algeciras, Tarifa, Barbate and Conil de la Frontera (Anonymous, 2001).

The red sea bream fishing in the Strait of Gibraltar waters is a fairly recent activity. It began to be carried out in the mid-seventies, by a ship from Ceuta, although its expansion took place in 1983 when, due to the limitations imposed by Morocco, disappeared most of the "Traíñas"* that the fishermen of Tarifa used to use. They saw in this resource an alternative to their traditional activity (García del Hoyo et al., 2002).

The voracera fleet has the possibility of working in well differentiated areas, locally called "pesqueros" (fishing grounds) associated with a certain situation and depth. Figure 1 shows the geographic location of these and the track of the fishing activity of the voracera fleet obtained from the analysis of the information from the Location and Monitoring System of Andalusian Fishing Vessels (SLSEPA), known as "green boxes". To the west of Tarifa we can see those locations where vessels of the fleet of this port works while to the east, between Algeciras and Ceuta, we find those fishing grounds exploited mainly by boats from Algeciras. It is not a general rule and, in fact, the daily choice of one fishing ground or another is the judgement of each captain.

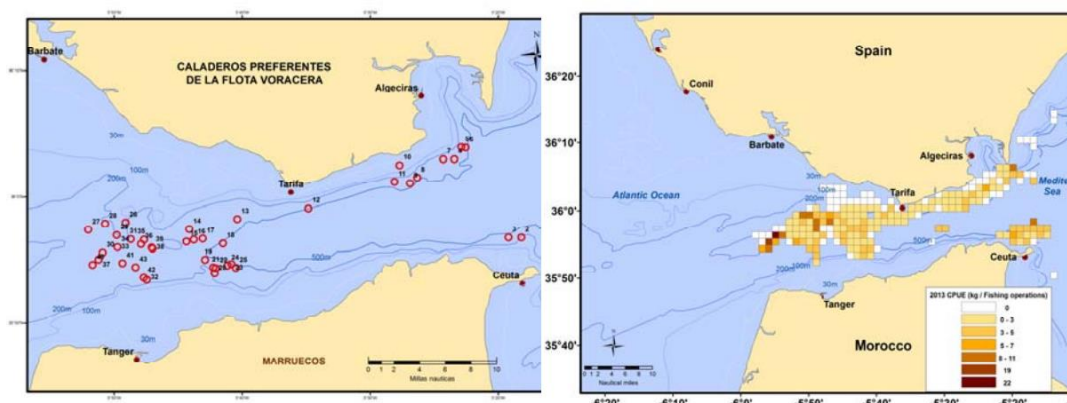


Figure 1. Preferred fishing grounds of the Spanish "voracera" fleet (left) and fishing footprint obtained from the information of the Location and Tracking System of Andalusian Fishing Vessels (right).

The fishing gear used by the fleet is a mechanized hand line called "voracera" (Figure 2), with its own peculiarities due to the particular hydrogeographic characteristics of the Strait of Gibraltar: it is composed of a main line, "arriaera", of about 2,000 meters of length rolled on a reel (Figure 2). The end of this main line is linked with a carabiner, to one of the ends of the voracera and to a lead of different weight.

The choice of lead type, large or small, depends on the tide strength. If the tidal coefficient is high, dates close to full and new moon, a big lead is used so that it does not lift from the sea bottom excessively.

On the contrary, if the tide does not have much force, they use a small lead since excess weight would hit the seabed too much. The mainline of the voracera, known as "tripa" (with a length of approximately 100 meters), has a range of from 60 to 90 branches of one meter length. These are separated by a 1.10 meters of distance and in each of them a fishhook with sardine is tied. At the end of the voracera is hooked, by means of a "falseta", a concrete stone (of about 15 kilos of weight carry the fishing gear to the bottom. The falseta can be formed by two, three or four wires depending, again, on the strength of the tide. Once the longline is at the bottom, ballasted at each end (by the stone in one and the lead in the other), the main line is taken and therefore also the voracera which pulls the falseta splitting it and leaving the stone in the background. The fishing takes place during the day, taking advantage of the tide change, commonly from low tide to high tide, not exceeding 500 fathoms in depth.

On each fishing day a variable number of sets are made, depending on the tides, weather conditions, technical characteristics of the boat... The captain gives the order to take the rig when he suspects, by "listening" the fishes, that there are specimens hooked to the longline (Figure 3). Currently, the "arriaeras" are collected by hydraulic reels located at the stern of the ship. However, the voracera, once removed from the carabiner and leads, is slowly getting on board the port side and can be roll up in the so-called "nails".



Figure 2. Fishing gear "voracera" (left) and hydraulic reels where the main line "arriaera" is rolled (right).

The Spanish artisanal fleet directed to the capture of the red sea bream in the area of the Strait of Gibraltar forms a group of boats well defined (component of fleet "voracera") as much by its technical characteristics as by the types of fishing trip that they carry out (Silva et al. al., 2002). Therefore, it can be considered a metier per se in which the red sea bream constitutes 2/3 of the total average catch, being the target species of this fishery. As by- catch species may be mentioned the blackbelly rosefish (*Helicolenus dactylopterus*), the horse mackerel (*Trachurus spp.*), The silver scabbardfish (*Lepidopus caudatus*), the atlantic pomfret (*Brama brama*) and, more rarely, the atlantic wreckfish (*Poliprion americanus*) and the dusky grouper (*Epinephelus guaza*).

Once sold, practically all of the red sea bream landings are subsequently distributed in those areas, central and northern Spain, with the greatest demand.



Figure 3. Voracera fleet vessel (left) and fishing operations (right).

The Spanish Institute of Oceanography (IEO) started monitoring and studying this fishery in 1997.

In addition to cover those aspects from the fishing activity itself, among the objectives of the study is to expand knowledge about the biological characteristics of the exploited resource: the high mobility of this species was already revealed by Gueguen (1974) through tagging and recapture experiences in the Cantabrian population and, from the Oceanographic Center of the IEO of Cádiz, nine (9) red sea bream marking-recapturing experiences have been carried out to date, in order to the study their movements, on different fractions of the population (juveniles and adults).

It is obvious that when the planning of the tagging campaigns were carried out, the objective was not the estimation of the survival of this species, although it is also evident that the realization of this type of campaigns requires to maintain the individuals tagged and returned to the sea in the best possible conditions to guarantee, precisely that: their survival.

In fact, the repetition of experiences in later years is precisely the result of the recapture rates obtained.

In this report references will be made mainly to the tagging experiences on the adult population that lives in the Strait of Gibraltar, since it is affected by the foreseeable establishment of a minimum landing size of 33 centimetres for this species in the NE Atlantic as by the implementation of the regulation of the landing obligation, since this species is regulated in the NE Atlantic with Total Admissible of Captures (TACs).

Methodology adult sampling campaigns

The campaigns required the boarding of a minimum of two scientists. The port of Tarifa was the starting and return point of each of the marking days with the fleet with voracera fishing gear. The port of Conil de la Frontera was the starting and return point in the case of the fleet with stone-ball longline type. The hooks of both fishing gears used were baited with pieces of sardine.

In 2001 the marking experiences on adults of red sea bream began:

From 19th February to 30th March the marking days were carried out in the fishing grounds known as “la discoteca”, “piedras malas”, “pesquera sur”, “tetones”, “tetones sur”, “pesquero Tarifa” y “la isla”. The following year, from 13th May to 19th June 2002, these were carried out in “la discoteca”, “el cementerio”, “el piconal” y “el vapor”. From 8th to 19th June 2004, these were carried out in “pesquero ceuta”, “el vapor”, “la farola”, “la mar nueva” y “el piconal del moro”, while from 18th May to 30th June 2006, specimens were marked on “la carretera”, “el cementerio”, “hoyito del moro”, “piconal”, “poniente vapor” and “vapor”.

For a better location of the different fishing grounds where the marking days were carried out the Annex of this report can be consulted. During the campaigns different fishing grounds were visited, to the east and to the west of the Strait of Gibraltar, ranging depths of setting the rigging between 179 and 522 meters, depending obviously on the fishing ground where they developed the fishing tasks.

The following marking activities of adults of red sea bream were carried out in 2006 and 2007, based in the port of Conil de la Frontera.

The purpose of these campaigns was to mark specimens in other fishing grounds, usually exploited by the fleet from Conil, which are more "remote" from the traditional bottoms of the voracera fleet, because geographically they are located on the westernmost side of the Strait of Gibraltar, in an area of border waters between Spain and Morocco, known as Majuan bank.

In addition, another aspect of interest of this activity was to check if there was a connection between the red sea bream core that inhabit the innermost areas of the strait and this westernmost fishing ground. Thus, from 21 to 26th July 2006 and from 6 to 14th August 2008, different marking days were carried out in these depths ranging from 182 to 437 meters. By way of summary, Table I presents the different marking experiences of adults of red sea bream carried out both in the area of the Strait of Gibraltar and in the Majuan bank.

Table 1. Descriptive summary of the marking experiences of adults of red sea bream (*Pagellus bogaraveo*) in the area of the Strait of Gibraltar and Majuan bank.

| Campaign | Days | Fishing Gear | Marking zone | | Number of marks | Average Size (cm) | Size Range (cm) |
|------------------|------|--------------|---------------------|--|-----------------|-------------------|-----------------|
| Tarifa 01 | 13 | Voracera | Strait of Gibraltar | | 979 | 34 | 21-52 |
| Tarifa 02 | 15 | Voracera | Strait of Gibraltar | | 624 | 35 | 21-47 |
| Tarifa 04 | 9 | Voracera | Strait of Gibraltar | | 942 | 30 | 20-47 |
| Tarifa 06 | 10 | Voracera | Strait of Gibraltar | | 1225 | 32 | 23-51 |
| Conil 06 | 4 | Longline | Majuan Bank | | 279 | 33 | 20-38 |
| Conil 08 | 5 | Longline | Majuan Bank | | 452 | 30 | 21-37 |

In all these experiences, the marking process has been similar, varying only the fishing gear used (voracera and depth longline stone-ball type) and the capture points (usual fishing grounds of the voracera fleet in the Strait of Gibraltar and the Majuan bank where the longline fleet of Conil de la Frontera works): with the specimens captured on board, and after keeping them in a nursery / aquarium for its acclimation, from each red sea bream apt for tagging, once the hook was released, it was noted down the total length up to the lower millimeter by using an ichthyometer while with the use of a marking gun, Mark II Scissor Grip type, an identifying mark, spaghetti ot-bar type, was inserted between the lateral line and the dorsal fin (Figures 4 and 5) .



Figure 4. Marking-recapture experiences of adults of red sea bream (*Pagellus bogaraveo*) with the voracera fleet in the Strait of Gibraltar: previous acclimation of adult specimens in the nursery (left) and release of the hook before the marking of the specimen (right).

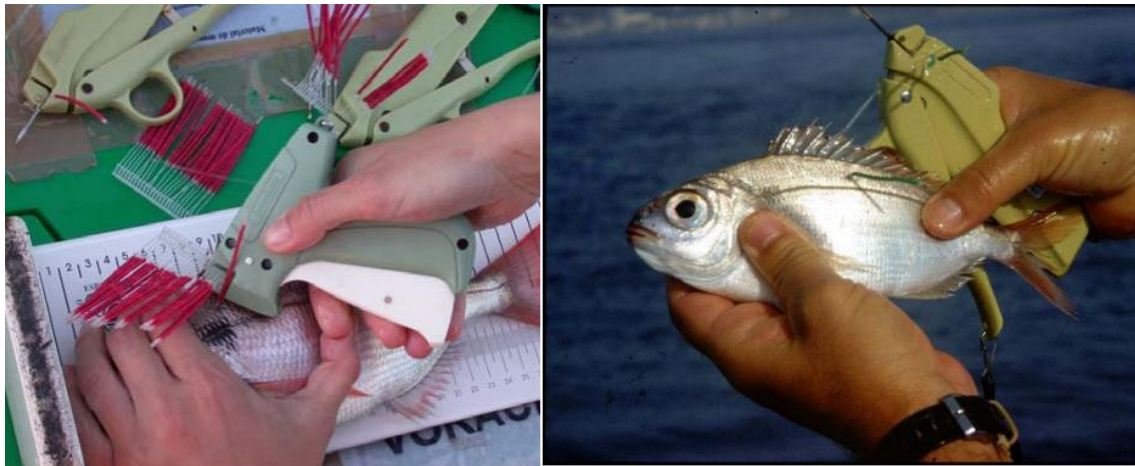


Figure 5. Marking-recapture experiences of adults of red sea bream (*Pagellus bogaraveo*) with the voracera fleet in the Strait of Gibraltar: measurement of the specimen and insertion of the identification mark.

Once the mark was inserted, the specimen was immediately returned to the sea. The mark has an identification number printed, the address and contact telephone number of the Oceanographic center of the IEO of Cádiz.

From each point where the captured, marked and release were carried out, the data associated with these maneuvers (geographical position, sea bottom, meteorology ...) and, for each mark, the size of the red sea bream released were recorded.

In this way, each mark number is associated to the size, the date of capture and the positions (and depths) of capture and release.

The voracera's setting time is scarce compared to other hooks gears, because the complete operation of starting, fishing and tacking of the rigging, can oscillate around 30-45 minutes. Therefore, during each fishing and/or marking day, several sets of the voracera are made, always during the change of the tide. In the case of marking experiences with longline stone-ball type, the setting time is much longer. First of all, in each fishing day three long lines were set and then collected, after a waiting period, starting by the longline set in the first place.

Discussion and results

The areas where the marking work was carried out were some of the usual fishing grounds of the Spanish voracera fleet which operates in the Strait of Gibraltar, the Bay of Ceuta, and nearby waters, where there is evidence of a significant concentration of juvenile specimens.

Probably the Bay of Ceuta next to the South Mediterranean area (from Estepona to La Línea), are the two points where the largest number of young red sea bream specimens are congregate before being recruited to the adult population that inhabits the deepest areas of the Strait of Gibraltar. Additionally, the Table II shows the number of marks, the number of recaptured and reported specimens and the recapture rate in each marking experience of the adults conducted to date.

Table II. Marking experiences of adults of red sea bream (*Pagellus bogaraveo*) in the area of the Strait of Gibraltar and Majuan bank: number of marks, number of reported recaptures and corresponding rate of recapture.

| Campaign | Number of marks | Number recaptures | of Recaptures rate (%) |
|-----------|-----------------|-------------------|------------------------|
| Tarifa 01 | 979 | 181 | 18,49 |
| Tarifa 02 | 624 | 34 | 5,44 |
| Tarifa 04 | 942 | 37 | 3,93 |
| Tarifa 06 | 1225 | 110 | 8,98 |
| Conil 06 | 279 | 31 | 11,11 |
| Conil 08 | 452 | 15 | 3,33 |

During the passage of the four (4) campaigns with the voracera fleet 3770 red sea breams were marked, as during the two (2) previous campaigns carried out with the longline fleet from Conil de la Frontera where 731 specimens were marked.

The average rate of recapture was close to 10% (9.1%), being 9.6% that obtained with the voracera fleet, and 6.3% with longline fleet. Both are greater than 5%, which is traditionally considered an acceptable recapture rate.

The record of permanence at sea corresponds to a red sea bream (34.5 centimeters length) marked on 26th February 2001 which was recaptured, on 31th July 2015, more than 14 years later (with a size of 45.5 centimeters). Another remarkable specimen was marked on 17th May 2002, with 41.8 centimeters total length, and recaptured, 13 years later, on 8th May 2015 with a total length of 49.5 centimeters.

Both are adult specimens, at least 4 years old. Both marks give us an idea of the longevity and slow growth of this species: Coupé (1954) estimated up to 12 years of age in specimens from the coasts of Morocco, while Ramos y Cendrero (1967), Gueguen (1969) and Sánchez (1983) reported maximum ages of 12, 20 and 10 years, respectively, for the Cantabrian population.

Regarding the population of the Azores, a maximum age of 15 years has been recorded in a specimen of 57 centimeters length (Krug, 1989).

In the population of the Strait of Gibraltar live specimens older than 14 years, as evidenced by the marking-recapture experiences, which show a fairly sedentary behavior being the individuals recaptured in the Strait of Gibraltar or in its proximity (such as the Majuan bank), few miles from the place of marking. In the same way, specimens marked in the Majuan bank have been recaptured by the voracera fleet in their usual fishing grounds. It should also be noted that, as expected, notifications of recaptures have been received from Moroccan vessels.

Figure 6, shows globally the time elapsed (in years of permanence at sea) between the marking process and the subsequent recapture of both experiences. According to this, throughout the first year there is a greater number of recaptures that then decrease with the passage of time.

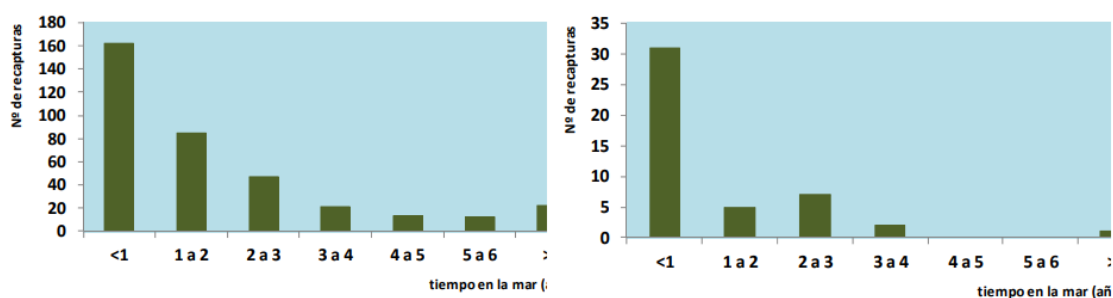


Figure 6. Marking experiences of adults of red sea bream: time (in years) elapsed between marking and recapturing of the specimens.

On the other hand, regarding the locations of reported recaptures, the movements of the adults of red sea bream marked in the studied area seem to be limited to movements between the different fishing grounds where the voracera fleet operates (Gil and Sobrino, 2006). The adult specimens swim across the Strait of Gibraltar in search of food. According to this, it does not seem too risky to consider the red sea bream of Strait of Gibraltar as a quasi-closed population unit, although this aspect should be validated with the use of other methodologies (i. e. genetic identification) as the absence of recaptures from more distanced points could be due to issues related to no notification of these recaptures.

Throughout these experiences of marking on adult specimens, it has been found that the appropriate size ranges were those that correspond to the smallest individuals. It seems that these bear better the stress associated with both fishing maneuvers and marking work: their behaviour after their release shown obvious signs of rapid recovery, going directed towards the sea bottom. In addition, as already mentioned, the marking of smaller specimens would provide more information regarding the growth rate if enough time elapsed before their recapture and was one of the aspects that should be covered in the study.

Conclusions

The marking campaigns carried out with the adults of this species on board the commercial fleet (voracera and stone-ball longline type) show the following results: during the years 2001, 2002, 2004 and 2006, aboard a voracera vessel of the Tarifa fleet, a total of 3770 specimens with an average total length of 32.1 centimeters (± 4.4 standard deviation) were marked and with a median in 31 centimeters total length.

Later, in the years 2006 and 2008, on board of two vessels of the artisanal fleet of Conil de la Frontera, a total of 731 specimens were marked with an average of total length of 31.2 centimeters (± 3.4 standard deviation) and a median in 32 centimeters of total length. The global recapture rates are, until now, 9.6% in the case of the voracera fleet and 6.2% with the stone-ball longline type.

Separating the obtained information, in greater and smaller than 33 centimeters, similar results are obtained: 9.89% and 6.40%, in the marked individuals smaller than 33 centimeters, in the voracera and stone-ball longline type, respectively and of 9.16% (voracera) and 6.15% (stone-ball longline type) in the marked specimens larger than 33 centimeters.

Higher survival rates are than those of recapture, so, in view of the foreseeable establishment of a minimum landing size of 33 centimeters, the design and development of ad hoc survival studies is recommended so that, regarding their results, the exemption of this species (and fishery) from the landing obligation can be assessed.

References

- Desbrosses, P., 1938. La dorade commune (*Pagellus centrodontus*) et sa pêche. Rev. Trav. Off. Pêches Marit., 5 (2): 167-222.
- Coupe, R., 1954. Cinquème note sur les Sparidés de la côte marocain, *Pagellus centrodontus* (Val. 1836). Journal du Conseil Permanent International pour L'Exploration de la Mer. 11 pp.
- García del Hoyo, J. J., F. García, M.D. González y M. L Vílchez, 2001. Políticas de gestión de pesquerías artesanales. Servicio de Publicaciones de la Universidad de Huelva, Huelva, 304 pp.
- Gueguen, J., 1969. Crissance de la dorade, *Pagellus centrodontus* Delaroche. Rev. Trav. Inst. Pêches Marit., 33 (3): 251-2547 Sánchez (1983).
- 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.
- Gil, J. e I. Sobrino, 2006. La pesquería del voraz en el estrecho de Gibraltar. En: Acuicultura, pesca y marisqueo en el Golfo de Cádiz. Consejería de Agricultura y Pesca. Junta de Andalucía. CD rom.

Krug, H. M., 1989. The Azorean blackspot seabream, *Pagellus bogaraveo* (Brunnich 1768) (Teleostei: Sparidae): Age and growth. *Cybiu*, 13: 347-355.

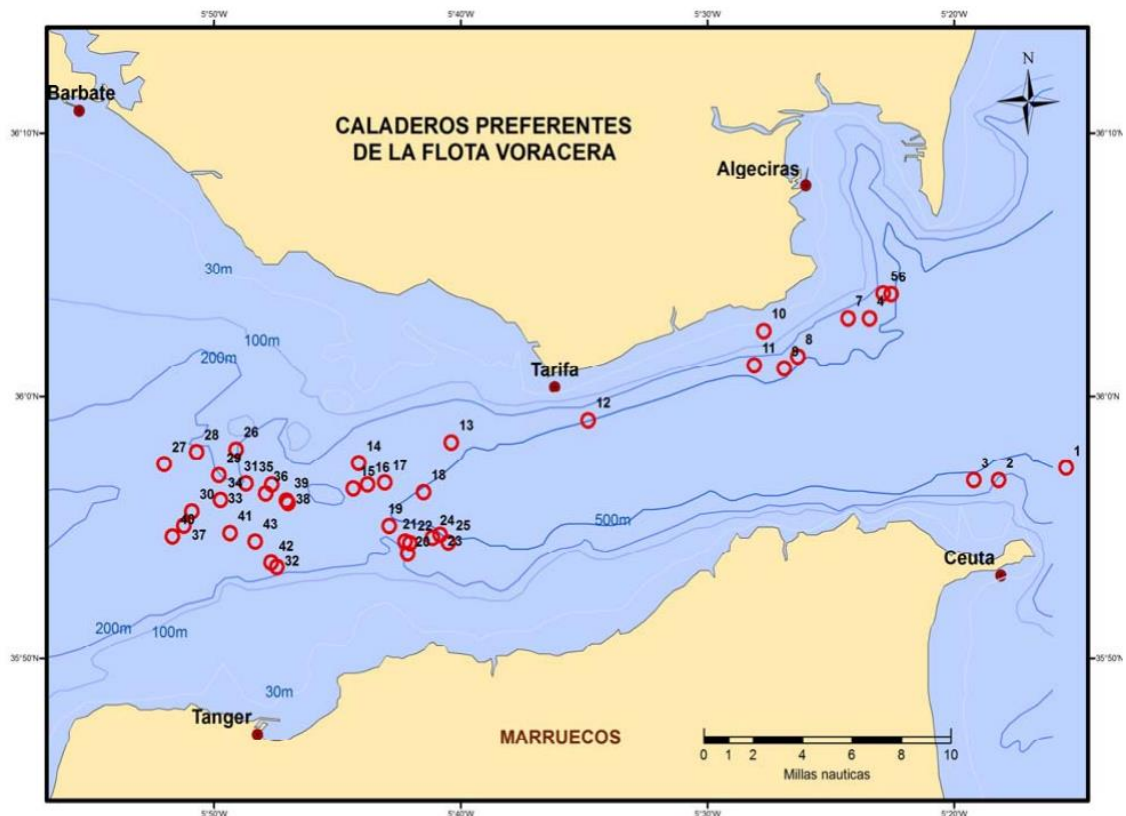
Ramos, F. y O. Cendrero, 1967. Notes on the age and growth of *Pagellus cantabricus* (Asso) of Northern Spain. ICES C.M. 1967/G:3. 8 pp.

Sánchez, F., 1983. Biology and fishery of the red sea-bream (*Pagellus bogaraveo* B.) in VI, VII and VIII Subareas of ICES. ICES C. M. 1983/G:38. 11 pp.

Silva, L., J. Gil e I. Sobrino, 2002. Definition of fleet components in the Spanish artisanal fishery of the Gulf of Cádiz (SW. Spain ICES Division IXa). *Fisheries Research*, 59: 117-128.

SPANISH OCEANOGRAPHY INSTITUTE

Annex: Location, denomination and geographic position of the fishing grounds frequented by the voracera fleet of the Strait of Gibraltar.



| Nº | Nombre | Latitud Norte | Longitud Oeste |
|----|-----------------|---------------|----------------|
| 1 | Pesquero Tarifa | 35° 59' 110 | 5° 34' 840 |
| 2 | Pesquero Ceuta | 35° 56' 820 | 5° 19' 200 |
| 3 | Pesquero 18 | 35° 56' 820 | 5° 18' 200 |
| 4 | Trueno | 35° 57' 300 | 5° 15' 460 |
| 5 | Carnero | 36° 02' 970 | 5° 24' 300 |
| 6 | La Bahía | 36° 03' 912 | 5° 34' 840 |
| 7 | Hoyo | 36° 02' 970 | 5° 23' 440 |
| 8 | Boca | 36° 03' 890 | 5° 22' 555 |
| 9 | Jeromito | 36° 01' 200 | 5° 28' 100 |
| 10 | Mar Tierra | 35° 56' 060 | 5° 49' 740 |
| 11 | Pollos | 36° 01' 080 | 5° 26' 890 |
| 12 | La Torre | 36° 01' 530 | 5° 26' 340 |
| 13 | Mar Nueva | 36° 07' 500 | 5° 27' 710 |
| 14 | Cuatro Millas | 35° 58' 260 | 5° 40' 380 |
| 15 | Cementerio | 35° 56' 730 | 5° 43' 080 |
| 16 | Las Bajas | 35° 55' 070 | 5° 42' 900 |
| 17 | Piconá | 35° 56' 500 | 5° 44' 350 |
| 18 | Cementerio W | 35° 56' 650 | 5° 43' 780 |
| 19 | Vapor | 35° 57' 480 | 5° 44' 140 |

| Nº | Nombre | Latitud Norte | Longitud Oeste |
|----|------------------------|---------------|----------------|
| 20 | Bajeta | 35° 54' 480 | 5° 42' 250 |
| 21 | Ferre Tetones | 35° 56' 060 | 5° 49' 740 |
| 22 | Norte Barbate | 35° 57' 440 | 5° 52' 020 |
| 23 | Norte | 35° 57' 900 | 5° 50' 700 |
| 24 | Tetones | 35° 57' 015 | 5° 49' 800 |
| 25 | Pesquero Sur | 35° 54' 670 | 5° 51' 680 |
| 26 | Parte Piedra | 35° 55' 950 | 5° 47' 000 |
| 27 | Moro | 35° 53' 480 | 5° 47' 450 |
| 28 | Sin Partir | 35° 54' 480 | 5° 48' 330 |
| 29 | Pesquero Patera | 35° 53' 650 | 5° 47' 680 |
| 30 | Piedras Malas | 35° 56' 040 | 5° 47' 060 |
| 31 | Discoteca | 35° 55' 620 | 5° 50' 900 |
| 32 | Discoteca Pollos | 35° 55' 080 | 5° 51' 220 |
| 33 | Cucharón | 35° 54' 800 | 5° 49' 350 |
| 34 | Pesquero Soler Levante | 35° 56' 690 | 5° 48' 700 |
| 35 | Pesquero Soler | 35° 68' 000 | 5° 49' 100 |
| 36 | Piedras Malas II | 35° 56' 300 | 5° 47' 900 |
| 37 | Bejaruco | 35° 56' 360 | 5° 41' 500 |
| 38 | Piedras Malas Soler | 35° 56' 660 | 5° 47' 660 |
| 39 | Bajeta España | 35° 54' 415 | 5° 42' 060 |
| 40 | Baja Moro Levante | 35° 54' 620 | 5° 41' 150 |
| 41 | Moro Moro | 35° 54' 000 | 5° 42' 150 |
| 42 | La Cala | 35° 54' 435 | 5° 40' 505 |
| 43 | La Cala España | 35° 54' 730 | 5° 40' 840 |

In Madrid, 3th of April 2017 INSTITUTO ESPAÑOL DE OCEANOGRAFIA